



JPL D-25796

# **Operations and Maintenance of the Deep Space Network**

## **Task Description Document**

*Deep Space Network*

**National Aeronautics and  
Space Administration**

**Jet Propulsion Laboratory  
California Institute of Technology  
Pasadena, California**

---

***March 21, 2003***

# Task Description Document

*Deep Space Network*

JPL D-25796

*March 21, 2003*

---

Prepared by:

\_\_\_\_\_  
Armond J. Salazar                      Date  
Contract Technical Manager,  
DSMS Operations Program Office

Concurred by:

\_\_\_\_\_  
Joseph A. Wackley                      Date  
Manager,  
DSMS Operations Program Office

Prepared by:

\_\_\_\_\_  
David J. Recce                      Date  
Alternate Contract Technical Manager,  
DSMS Operations Program Office

Approved by:

\_\_\_\_\_  
Peter E. Doms                      Date  
DSMS Program Manager

**National Aeronautics and  
Space Administration**

**Jet Propulsion Laboratory  
California Institute of Technology  
Pasadena, California**

## DOCUMENT CHANGE LOG

---

Date	Sections Changed	Reason for Change	Revision
2/14/2003	Entire Document		Rev 0 draft
3/06/2003	Entire Document	Incorporates information that became available after the draft was published, such as proposal addenda or responses to requests for clarification.	Rev 0
3/21/03	Sections 1 and 2	Minor changes for clarification; no substantive changes.	Rev. 1



# CONTENTS

---

Document Change Log.....	v
Preface .....	xiii
<b>1 Management.....</b>	<b>1-1</b>
1.1 Contract Management .....	1-2
1.1.1 Financial Management .....	1-2
1.1.2 Procurement and Subcontracts Management .....	1-3
1.1.3 Safety and Health Management .....	1-3
1.1.4 System Safety Management .....	1-4
1.1.5 Environmental Management .....	1-5
1.1.6 Physical Security Management .....	1-6
1.1.7 Information Technology Security Management.....	1-7
1.2 Facilities Management.....	1-7
1.3 Property Management .....	1-8
1.4 Administrative Infrastructure Support.....	1-9
1.4.1 Office Support .....	1-9
1.4.2 Computing Infrastructure .....	1-9
1.5 Program Integration.....	1-10
1.6 Risk Management .....	1-10
1.7 Training and Certification Program.....	1-11
1.8 Contract Performance Metrics.....	1-12
<b>2 Goldstone Deep Space Communications Complex Operations.....</b>	<b>2-1</b>
2.1 Deep Space Communications Complex Management .....	2-3
2.1.1 Radio Frequency Coordination .....	2-5
2.1.2 GDSCC Site Security .....	2-7
2.1.3 Safety and Health Compliance .....	2-8
2.1.4 Environmental Compliance .....	2-10
2.1.5 Energy and Water Management .....	2-12
2.1.6 Intracomplex Communications .....	2-13
2.1.7 Information Management .....	2-14
2.1.8 Support Services.....	2-14
2.1.8.1 Sanitation/Custodial Services .....	2-14
2.1.8.2 Landscaping Services .....	2-15
2.1.8.3 Food Services .....	2-15
2.1.8.4 Transportation.....	2-15
2.1.8.5 Heavy Equipment .....	2-16
2.1.9 Outreach Program Activities and Products .....	2-16
2.1.10 DOD Interface .....	2-17
2.1.11 Airspace Coordination.....	2-18
2.2 Real-Time Operations .....	2-18
2.3 Antenna/Mechanical Maintenance .....	2-20
2.3.1 Structural Assembly .....	2-21

## Contents

2.3.2	Mechanical Assembly .....	2-21
2.3.3	Cassegrain Assembly .....	2-22
2.3.4	Special Tooling and Instrumentation .....	2-22
2.4	Technical Systems Maintenance .....	2-23
2.4.1	Goldstone Technical System Maintenance .....	2-24
2.4.2	Maintenance of the GDSCC Maintenance Facility.....	2-24
2.5	Facilities and Infrastructure Maintenance and Construction/ Modification.....	2-26
2.5.1	Technical Plant Maintenance .....	2-27
2.5.1.1	Heating, Ventilation, and Air Conditioning .....	2-27
2.5.1.2	Plumbing .....	2-27
2.5.1.3	Electrical and Power Distribution System .....	2-28
2.5.1.4	Power Plant .....	2-29
2.5.1.5	Water Supply .....	2-29
2.5.1.6	Airport .....	2-30
2.5.1.7	Buildings .....	2-30
2.5.1.8	Roads and Drainage Systems .....	2-30
2.5.1.9	Septic System and Oxidation Ponds.....	2-31
2.5.1.10	Landfill.....	2-31
2.5.1.11	DSN Facilities Master Plan .....	2-32
2.5.2	Heavy Equipment Maintenance .....	2-32
2.6	Advanced Systems Operations and Maintenance .....	2-32
2.6.1	GDSCC Technology and Science Support .....	2-33
2.6.2	High-Power Transmitter Test Facility .....	2-36
2.7	Technical Services.....	2-37
2.7.1	Workmanship Assurance .....	2-37
2.7.2	Documentation .....	2-37
2.7.3	Training and Certification.....	2-38
2.7.4	Logistics .....	2-38
2.7.5	Supply Disbursement .....	2-39
2.7.6	GDSCC Procurements .....	2-39
<b>3</b>	<b>Network Operations and Services .....</b>	<b>3-1</b>
3.1	Network Operations .....	3-1
3.1.1	Control Center Real-Time Operations .....	3-3
3.1.1.1	Real-Time Operations Control and Monitoring.....	3-3
3.1.1.2	Option to Relocate NOCC and Data Systems Operations Monitor Functions .....	3-6
3.1.1.3	Central Communications Terminal Operations.....	3-7
3.1.2	Operations Support Services.....	3-7
3.1.3	Control Center Maintenance .....	3-9
3.1.3.1	DSOCC Maintenance.....	3-9
3.1.3.2	Central Communications Terminal Maintenance .....	3-9
3.1.4	Performance Analysis .....	3-10
3.1.4.1	Performance Analysis .....	3-10
3.1.4.2	Performance Metrics Generation .....	3-12
3.1.5	Network Activities Planning and Scheduling .....	3-13
3.1.5.1	Resource Analysis Team.....	3-13

3.1.5.2	Network Activities Planning and Scheduling.....	3-16
	Short-Term Scheduling .....	3-17
	Non-Real-Time Scheduling.....	3-17
	Real-Time Scheduling.....	3-17
	Analysis and Support.....	3-17
	Requirements .....	3-17
3.1.6	Mission-Specific Planning and Preparation .....	3-18
3.1.7	Mission-Independent Products and Procedures (SOPs).....	3-21
3.2	Network Support Services.....	3-21
3.2.1	Development and Test Services .....	3-22
3.2.2	Change Management Tools and Administration.....	3-25
3.2.3	Network Documentation .....	3-26
3.2.4	Network Maintenance Support.....	3-27
3.2.5	Logistical Services .....	3-28
<b>4</b>	<b>Network Engineering .....</b>	<b>4-1</b>
4.1	DSN Engineering .....	4-1
4.1.1	Facilities Implementation Planning.....	4-3
4.1.2	Antenna-Mechanical Network Engineering.....	4-4
4.1.2.1	Structural Engineering.....	4-4
4.1.2.2	Mechanical Engineering.....	4-5
4.1.2.3	Cassegrain Assembly .....	4-5
4.1.2.4	Special Tooling and Instrumentation.....	4-6
4.1.3	Microwave Network Engineering .....	4-6
4.1.4	Data-Processing-Subsystems Network Engineering .....	4-7
4.1.5	Communications System Network Engineering .....	4-7
4.1.6	Test Engineering .....	4-8
4.2	Product Development and Sustaining Engineering.....	4-9
4.2.1	Facilities Development and Sustaining .....	4-10
4.2.1.1	Facilities Subsystem Engineering.....	4-11
4.2.1.2	Facilities Design Engineering.....	4-12
4.2.2	Test Product Development Engineering.....	4-13
<b>5</b>	<b>Directed Efforts/Tasks .....</b>	<b>5-1</b>
5.1	Product Development and Sustaining .....	5-1
5.2	Construction and Major Modification to Existing Facilities.....	5-2
5.3	Short-Term Work .....	5-3
5.4	Changes to the TDD .....	5-3
5.5	Emergency Requirements.....	5-3
<b>6</b>	<b>Appendix A: Acronyms and Other Abbreviations.....</b>	<b>6-1</b>
<b>7</b>	<b>Appendix B: Glossary .....</b>	<b>7-1</b>
<b>8</b>	<b>Appendix C: Applicable Documents.....</b>	<b>8-1</b>
<b>9</b>	<b>Appendix D: GDSCC Map .....</b>	<b>9-1</b>
<b>10</b>	<b>Appendix E: DSMS Processes .....</b>	<b>10-1</b>

## Contents

<b>11</b>	<b>Appendix F: Service Commitment Process .....</b>	<b>11-1</b>
<b>12</b>	<b>Appendix G: Service Capabilities Development Process.....</b>	<b>12-1</b>
<b>13</b>	<b>Appendix H: Service Execution Process .....</b>	<b>13-1</b>
<b>14</b>	<b>Appendix I: Product Engineering Assignments .....</b>	<b>14-1</b>
<b>15</b>	<b>Appendix J: Contractor Staff Roles .....</b>	<b>15-1</b>



## ILLUSTRATIONS

---

Figure 9-1:	GDSCC and vicinity.....	9-3
Figure 10-1:	DSMS Processes.....	10-1
Figure 11-1:	Inputs, Controls, Outputs, and Resources for the Service Commitment Process.....	11-1
Figure 12-1:	Overview of the Procedures for the SCD Process.....	12-1
Figure 12-2:	SCD Process Timeline for a Simple Case .....	12-2
Figure 12-3:	SCD Process Timeline with SVE additions .....	12-3
Figure 13-1:	Service Execution Process.....	13-1
Figure 13-2:	SVE Process Inputs, Controls, Outputs, and Resources.....	13-2
Table 6-1:	Acronyms and Other Abbreviations .....	6-1
Table 7-1:	Glossary .....	7-1
Table 8-1:	Applicable Documents .....	8-1
Table 15-1:	Staff Roles Referenced by WBS Element Number .....	15-1



# PREFACE

---

The Deep Space Network (DSN) was established by NASA and JPL to support the exploration of space, primarily by robotic spacecraft. JPL is responsible for the ongoing engineering development of the network and for its operations and maintenance (O&M). A contractor to JPL provides the O&M of the Goldstone Deep Space Communication Complex, the technical direction for O&M at other complexes, and other network support services.

This task description document (TDD) describes the management, GDSCC O&M, network engineering, and directed services that the Contractor must perform under the JPL DSN O&M Contract (CEF 567818). These services specifically include the following tasks:

- Planning
- GDSCC operations
- GDSCC maintenance
- Network operations control
- Problem analysis and resolution
- Network engineering support of JPL
- Compatibility test support
- Mission-operations planning for flight project support
- Radar and radio-astronomy support
- Logistical support

This body of this TDD is organized to reflect the work breakdown structure (WBS) of DSN O&M tasking. Heading numbers and heading text in the main document correspond to hierarchical WBS numbers and elements. The four top-level WBS elements correspond to sections 1 through 5 of the document—the “body” of the document.

Each subsection in the body corresponds to a WBS element. Each subsection begins with a task description and goes on to describe contractor requirements. Special provisions are included in the requirements or called out following them. Content in higher-level sections flows down and applies to all subsections. For example, any requirements in Section 2.X apply to section 2.X.1, 2.X.2, 2.X.3, and so on.

Other information related to the task is appended. Appendix A is a list of acronyms, initializations, and abbreviations, as well as their expansions. Appendix B is a glossary of terms and their definitions. Appendix C is a list of references, including applicable documents cited in the requirements. All documents cited or referenced documents are included in this TDD by reference. Appendix D is a map of the GDSCC. Appendixes E, F, G, and H are process flowcharts, for reference. Appendix I is product engineering assignments, and Appendix J describes in detail Contractor staff roles that are cited in the body as requirements or special provisions (also required).

This March 21, 2003 version of the TDD is the revision of the draft TDD of 14 February 2003. This revision incorporates information that became available after the February draft was published, such as proposal addenda or responses to requests for clarification. Change bars indicate the changes from the February draft.

After the current AOP is approved, the scope of this TDD may change because of changes in requirements for JPL-directed support or changes in the level of support required by TDD tasks. The changes will normally involve staffing and be of sufficient duration to be included in the next revision of the TDD.

# 1 MANAGEMENT

---

To meet the challenge of providing Deep Space Network (DSN) operations and maintenance (O&M) in a timely and cost-efficient manner, the Contractor must integrate the O&M activities into a cohesive program. The Contractor must manage the program so that it provides the Deep Space Mission System (DSMS) and the National Aeronautics and Space Administration (NASA) with insight into the Contractor's costs, schedule, and performance.

The Contractor Manager will be the Contractor's primary contact with the Jet Propulsion Laboratory (JPL) Contract Technical Manager (CTM), who resides in the Interplanetary Network Directorate (IND) of the DSMS Operations Program Office. The CTM will establish an interface with the Contractor Manager, to transmit the DSN technical guidelines, policies, and constraints under which the Contractor must operate. The CTM will also provide contract evaluation reports to the Contractor Manager, who will be expected to respond with immediate, decisive steps to correct any weaknesses identified. The Contractor Manager will be responsible and accountable for the Contractor's overall technical, cost, and schedule performance.

Except as otherwise specified in the contract, the Contractor will provide all the personnel and other resources necessary to manage and report on the contract. The execution of the tasks described in this document requires unique technical knowledge and experience, that is, some combination of—if not all of—the following personnel qualifications:

- College degree (at least BA/BS), in technical areas (science, engineering, or mathematics)
- Experience in the general area of spacecraft tracking network operations and maintenance
- Specialized skills applicable within the general area of spacecraft tracking network operations and maintenance

The Contractor will assess each candidate for a position against the task requirements for that position. An important measure of the Contractor's performance on this contract will be its ability to fill required positions with qualified staff members.

The following sections describe contract management subtasks.

## 1.1 Contract Management

The Contractor will manage its JPL DSN O&M contract.

In support of this task, the Contractor shall:

1. Be responsible and accountable for the schedule, cost, and performance of all the tasks described in this document.
2. Maintain a management interface with the CTM.
3. Establish, document, and implement processes for providing direct and timely technical support to the DSCCs in Canberra, Australia, and Madrid, Spain.
4. Respond to contract performance evaluations, taking immediate and decisive steps to correct the weaknesses cited.
5. Respond to the CTM's requests for assigning Contractor resources to meet short-term demands, as required by unanticipated or accelerated task requirements levied on the DSN.
6. Establish, document, and implement Contractor processes to improve performance, reduce cost, and increase customer satisfaction.
7. Be responsible for the conduct and performance of Contractor personnel.
8. Provide required reports to NASA and JPL (through the CTM), as required in the JPL Prime Contract or upon request of the CTM.
9. Be responsible for obtaining and maintaining all permits required for the performance of the work in this contract.
10. Be responsible for all contract deliverables listed in the Contract Data Requirements List (CDRL).

### 1.1.1 Financial Management

The Contractor will manage the financial aspects of this contract. As part of this task, the Contractor will provide monthly actual costs, special accrual reports, and other financial data requested by the CTM. These data are critical to programmatic management by the DSMS Operations Program Office.

In support of this task, the Contractor shall:

1. Provide and maintain a financial management system for planning, tracking, accumulating, and reporting contract costs and for providing other financial support to meet the budgeting, cost reporting, billing, and disclosure requirements of the contract.
2. Prepare and submit an Annual Operating Plan (AOP), in response to DSMS-provided budget guidelines and as described in the CDRL (for document M018).
3. Monitor and control the costs associated with performing the tasks described in this TDD.
4. Provide actual expenditures and estimated expenditures incurred for contract work orders (CWOs) versus planned cost.

5. Provide reports of monthly actual costs, special accrual costs, and other financial data requested by the CTM.
6. Support the DSMS Operations Program Operating Plan (POP) by providing additional data as required by the DSMS Operations Program Office.
7. Support the DSMS Operations Program Office in special cost studies for the DSMS program office, NASA, or as requested by the CTM.

### **1.1.2 Procurement and Subcontracts Management**

The Contractor is responsible for any procurement—including subcontracts—it requires to support this contract.

In support of this task, the Contractor shall:

1. Establish a procurement capability. The Contractor procurement capability shall guarantee all materials and supplies are obtained in a cost-effective and timely manner, and that no DSN commitment is jeopardized by the late delivery of material and supplies.
2. Operate the DSN procurement capability in accordance with JPL, NASA, and Contractor procurement standards.
3. Provide for the purchasing and subcontracting of materials and services, including any equipment required to perform the tasks described in this TDD.
4. Provide access to procurement records to JPL, the California Institute of Technology, and U.S. Government auditors.

### **1.1.3 Safety and Health Management**

Many Contractor activities will be conducted in an environment that could significantly affect employee health and safety. In particular, many of the activities at the Goldstone DSCC (GDSCC) will involve large, mechanical moving structures; electromagnetic radiation; and hazardous materials. The Contractor must establish and manage an effective safety-and-health program to protect personnel, equipment, antenna structures, and facilities.

The Contractor facilities in the Pasadena area and the GDSCC are considered multi-employer worksites; therefore, the Contractor is responsible for ensuring the safety and health of its employees, JPL employees, JPL subcontractor employees, and all other visitors to GDSCC and Contractor facilities.

In support of this task, the Contractor shall:

1. Implement a safety-and-health management plan that is intended to prevent damage to or destruction of material equipment and facilities; and to ensure a safe, healthy environment for all personnel using or visiting Contractor-operated facilities.
  - a. As part of the plan implementation, establish and manage a comprehensive safety program at GDSCC, including personnel safety

training, accident prevention, investigation and reporting, emergency preparedness, fire prevention, and the procurement of safety supplies and fire suppression supplies.

- b. Identify and define personnel health and safety measures, including the identification, evaluation, and abatement of potential workplace hazards; safe work practices and work procedures; communication system; enforcement and disciplinary systems; training and record keeping; and accident/incident investigation.
  - c. Define fire prevention and suppression measures, including confined-space entry; high-voltage electrical safety; lockouts, tagouts, and blockouts; electromagnetic radiation and radio-frequency hazards; rotating machinery hazards; hazardous and toxic substances; high fluid pressure hazards; and dangerous obstructions.
  - d. Emphasize injury and illness prevention and establish an effective first-aid and cardiopulmonary-resuscitation training program.
  - e. Document conformance to the California Code of Regulations (CCR), Title 8, *General Industrial Safety Orders (GISO)*, as applicable, and a site-specific safety plan.
  - f. Develop response and recovery actions for natural disasters such as earthquakes, fires, floods, and high winds.
2. Respond to NASA, JPL, federal, state, and local regulations and reporting requirements as specified in Appendix C, Applicable Documents.
  3. Conform to the applicable NASA Procedures and Guidelines (NPGs), NASA Policy Documents (NPDs), and executive orders listed in Appendix C, Applicable Documents.

This task has a special provision:

1. The management plan shall be implemented and maintained by a Certified Safety Professional (CSP), as described in Appendix J, Contractor Staff Roles.

#### **1.1.4 System Safety Management**

The Contractor will manage and report on system safety.

In support of this task, the Contractor shall:

1. Implement and document, according to the CDRL, the Systems Safety Plan (document M010). The plan shall assess testing, operations, system modification, implementation, and maintenance activities for hazards to personnel, critical hardware, and facilities.
2. Comply with the requirements of D-560, *JPL Standard for Systems Safety*, as applicable.
3. Implement a risk management process, in accordance with NASA/JPL policies and requirements for hazard reduction, for maximizing protection against personnel injury and/or property damage.



4. Describe how the Contractor's safety organization becomes aware of, and gains insight into, other organization's activities that occur within the Contractor's sphere of responsibility.
5. Utilize processes required for OSHA compliance that also show the Contractor's management structure and its interactions with the processes.
6. Prepare and submit periodic reports as described for M010, Systems Safety Plan, in the CDRL.

This task has a special provision:

1. The management plan shall be implemented and maintained by a CSP, as described in Appendix J, Contractor Staff Roles.

### 1.1.5 Environmental Management

The facilities to be operated by the Contractor—especially the GDSCC—are subject to stringent local, state, and federal environmental regulations. For all of the locations at which this contract is performed—except within JPL—the Contractor will establish an environmental management program that complies with all applicable NASA, JPL, federal, state, and local environmental requirements.

In support of this task, the Contractor shall:

1. Establish, document, and implement an environmental management program in accordance with all applicable federal, state, and local regulatory requirements, and in accordance with other government policies including:
  - a. NPD 8500.1, *NASA Environmental Management*.
  - b. NPG 8820.3: *Pollution Prevention*, subject to state and local requirements for reporting hazardous material changes. Those requirements should meet or exceed the federal schedules in Chapter 6 of the NPG.
  - c. NPG 8830.1, *Affirmative Procurement of Environmentally Preferable Products*.
  - d. NPG 8580.1, *Implementing the National Environmental Policy Act and Executive Order 12114*.
  - e. The Resource Conservation and Recovery Act (RCRA), the Clean Air Act, the Endangered Species Act, and the National Historic Preservation Act.
  - f. Executive Orders as set forth in Appendix C, Applicable Documents.
2. Report all known usage and disposal of hazardous material to JPL Office 530 and the CTM, within 30 days of the discovery, disturbance, or removal of any hazardous material.
3. Report any identified environmental-protection problems to JPL Office 530 and the CTM.

### 1.1.6 Physical Security Management

Many of the contractor-operated facilities are considered minimum essential infrastructure for accomplishing NASA's mission. These include the GDSCC and the Remote Operations Support Area (ROSA). Other facilities are involved in ensuring the success of mission-critical events such as compatibility testing and the support-data generation.

To maintain the integrity of these contractor-operated facilities, the Contractor will provide a security program in accordance with the latest issuances of the *National Industrial Security Program Operating Manual*; NPG 1620.1, *Security Procedures and Guidelines*, Presidential Decision Directives, and other, NASA site-specific regulations.

In support of this task, the Contractor shall:

1. Protect/safeguard personnel, facilities, assets, and equipment; classified information and materials; and unclassified sensitive, technological data and information.
2. Implement and adhere to NASA and Department of Defense (DOD) regulations governing NASA Security and NASA Resource Protection.
3. Provide security engineering, maintenance, and operations for systems protecting classified information.
4. Develop and document a security plan that satisfies the requirements of the latest issuances of NPG 1620.1, *Security Procedures and Guidelines*; Presidential Decision Directives; and *National Industrial Security Program Operating Manual*, DOD 5220.22.
  - a. For the GDSCC, take into consideration Code X NRP waivers, the site's remote location, its location with respect to Ft. Irwin and other military reservations, and its large size.
5. Provide security guards at the GDSCC.
6. Provide site and building security that controls and records building access.
7. Provide passive security in conformance with the previously referenced documents.
8. Provide reporting and logging processes, procedures and mechanisms for security-related incidents, including unauthorized access, unauthorized removal, or damage to equipment, threats, and civil code violations.
9. Interact with JPL Security, to ensure continued compliance with current homeland and NASA Resource Protection (NRP) Program security requirements and status.
10. Interface with JPL security to maintain Force Condition (Force Con) levels consistent with the DOD (at GDSCC) and JPL (at ROSA and Contractor facilities).

11. Submit reports as required to the CTM, JPL security, and the JPL/NASA Management Office (NMO).
12. Submit to NASA/JPL audits of security plans and capabilities, as requested or scheduled.

### 1.1.7 Information Technology Security Management

The information technology security (ITS) program levied on the Contractor is based on the JPL ITS program. The ITS program protects information that, although publicly releasable, requires high standards of integrity and availability in its use by NASA/JPL. It protects sensitive unclassified information, including Privacy Act information, proprietary data, International Traffic in Arms Regulations (ITAR) data, and technology embargoed from foreign dissemination for competitive reasons. The ITS program includes identifying vulnerabilities to the systems, assessing risk, establishing the configuration of the IT Systems, and identifying and assessing the risk posed by asset additions.

In support of this task, the Contractor shall:

1. Implement a proactive ITS program for flight operations that meets the minimum requirements of the DSMS program specified in JPL Document D-23140, *DSMS Information Technology Security Policy*, and JPL Document D-17896, *DSMS Information Technology Security Requirements for Computer Systems*.
2. For each location that NASA/JPL furnishes for the Contractor information technology and telecommunications systems, implement at least JPL Document D-7155, *JPL IT Security Requirements for Computer Systems*, and JPL Document D-7223, *JPL IT Security Requirements*.
3. Protect sensitive, unclassified information including Privacy Act information, proprietary data, ITAR data, U.S. Export Administration Regulations (EAR) data, NASA-defined mission data (MSN), and NASA-defined business and restricted technology (BRT) data.

## 1.2 Facilities Management

The Contractor will provide maintenance, operations, and sustaining engineering of facilities leased by the Contractor and used as operational facilities by JPL.

In support of this task, the Contractor shall:

1. Coordinate and manage the modifications to and maintenance of Contractor-leased facilities, including the communications and security systems.
2. For Government-provided real property, develop, implement, and maintain a real-property management plan.

3. For Government-provided real property at the GDSCC, provide “brick and mortar” services.
4. Coordinate with the CTM on any plans for new or upgraded facilities and their cost to the contract.

### 1.3 Property Management

To perform the task described in this TDD, the Contractor will be provided with Government-furnished property (GFP), which the Contractor must manage. GFP is located in Contractor-leased facilities, Contractor-operated facilities, and government facilities such as GDSCC. Because of the widespread locations, diversity, and use of the GFP, the Contractor must establish effective, ongoing processes for managing GFP. During annual inventories, the Contractor must also account for all GFP.

In support of this task, the Contractor shall:

1. Establish and maintain a property management plan, in accordance with M014 Real Property Management Plan and M015 Government Property Management Plan, as described in the CDRL.
2. Manage all property owned, leased, or acquired by NASA/JPL under the terms of this contract.
3. Manage and control administrative and technical GFP provided by JPL.
4. Identify, control inventory of, keep records on, report on, and maintain a database of controllable property.
5. Establish a process and procedures to control and account for all GFP across Contractor organizations regardless of their location.
6. Store, control the inventory of, and account for all GFP, including:
  - a. Equipment sent to commercial vendors or to JPL for repair or calibration.
  - b. Equipment temporarily or permanently transferred to DSN facilities.
7. Catalog, control the serialization of, and trace the identity of all items introduced into the DSN.
8. Control the numbering system used to identify buildings and structures (real property) at GDSCC.
9. Inventory all GDSCC buildings and structures and submit forms for updating the NASA Real Property Database. Provide historical data for the duration of the contract, and report to the JPL Property Administrator all additions, modifications, and deletions to the buildings and structures, in accordance with NPG 8800.15, *Real Estate Management Program Implementation Manual*.
10. Maintain the GDSCC Gold Book, which provides drawings and specification details of all updates to GDSCC facilities, sites, structures, and infrastructure.

11. Maintain records and files of all GFP and transactions, for NASA, JPL, and Government audits.
12. Report monthly to the CTM an inventory of all government-owned vehicles:
  - a. Fuel consumption
  - b. Vehicle maintenance
  - c. Commercial-vehicle identification and condition,
  - d. For vehicles other than sedans, gross vehicle weight, and fuel type (gas, diesel, electrical, or alternate fuel)

## 1.4 Administrative Infrastructure Support

The Contractor will provide and account for all office furniture, computers, and computer network resources—whether GFP or Contractor-provided—it requires for the performance of the contract.

### 1.4.1 Office Support

The Contractor will provide office supplies and equipment, including furniture, copiers, viewgraphs, video-conferencing equipment, telephones, and pagers.

In support of this task, the Contractor shall:

1. Provide all office support equipment and supplies directly related to the performance of the tasks described in this TDD.
  - a. Provide phones, faxes, video conferencing, and copiers, as needed for the performance of the contract.
  - b. Replenish all equipment and supplies in a manner that is cost effective to NASA and JPL.

### 1.4.2 Computing Infrastructure

The Contractor will support the computers and computer networks at Contractor facilities and communications interfaces to JPL. Administrative computers include the PCs and workstations that the Contractor uses to support network operations. Communications interfaces include local area networks (LANs) in contractor facilities and communications lines, including fiber-optic lines that run between contractor systems to JPL and to the Contractor-leased facilities. DSMS will provide the connectivity (“point of presence”) at the JPL Oak Grove Facility.

In support of this task, the Contractor shall:

1. Provide PCs and computer workstations that the Contractor will use directly to support network operations.
2. Ensure that PCs and computer workstations are not more than three years out of date.
3. Provide the LANs for networking computers at contractor facilities.

4. Provide communication interfaces between JPL and the Contractor facilities used for this contract, and maintain the fiber-optic and other communication lines that constitute the physical component of these interfaces.
5. Provide computer support, including E-mail administration, database administration, system analysis and design, software and hardware configuration control, administrative software maintenance and development, system administration, and the computer training required for this contract.
6. Provide integrated services digital network (ISDN) lines as needed for the performance of the contract.

## 1.5 Program Integration

The Contractor will integrate program activities into a detailed strategic plan. This plan will integrate high-level mission milestones, DSN operations milestones, and DSMS engineering milestones with the Contractor's mission preparation activities, maintenance activities, resource requirements, and costs.

In support of this task, the Contractor shall:

1. Generate and maintain a detailed schedule that includes key mission activities, key critical events, completion dates for contractually required documents, DSN preparation plans, DSN preparation activities, implementation support, and reviews.
2. Generate and maintain a strategic plan covering at least two fiscal years, to define future personnel requirements and assignments, schedules and costs.
3. Assign multidisciplinary teams to develop and execute plans such as plans for mission-support preparation, anomaly resolution, and implementation activities.
4. Provide integrated plans to DSMS Operations Program Office.
5. Periodically provide status reports to DSMS Operations Program Office.
6. Include strategic plan results in the development of the AOP.

## 1.6 Risk Management

By its very nature, the DSN support of flight projects entails a high level of ongoing, day-to-day risk. Some obvious factors contributing to this risk are:

- Multiple, interactive, and exceedingly complex data systems and control systems
- Software-based systems requiring extensive operator knowledge and interaction
- Continuous implementation of system upgrades and new capabilities, all requiring extensive, ongoing operator training and hands-on experience

- Ever-increasing complexity of mission operations, which increase the complexity of the DSMS support operations, as typified by the operations for the Mars Exploration Rover mission
- The aging of antenna structures and other major equipment, increasing the probability of serious or even catastrophic structural or equipment failures
- Continuous budget reduction threats, which could reduce DSMS operations funding with no corresponding change in costs

The Contractor must plan to anticipate such risks and to identify strategies to mitigate them. The Contractor must also factor into the overall risk management plan and process “lessons learned” from failures and other anomalous incidents. The Contractor should be able to mitigate most risks with existing Contractor resources.

In support of this task, the Contractor shall:

1. Develop the Risk Management Plan, as described for document M017 in the CDRL, in accordance with NPG 8000.4, *Risk Management Procedures and Guidelines*.
2. Analyze the “state of the DSN” at regular intervals, including identifying factors that could contribute to quantifiable or probable risks to DSMS operations.
3. Develop and maintain a prioritized list of anticipated risks:
  - a. Assess of the severity of the risk (that is, its potential effect on the flight project customer and the DSN), and the anticipated frequency or probability of the risk occurring.
  - b. Determine the relative priority of the risk through a combination of these two parameters (severity and probability)
  - c. Ensure the prioritized list documents the preceding information
4. Develop strategies to mitigate the anticipated risks.
5. Once each quarter, or as directed by the DSMS Operations Program Office, explore with the DSMS Operations Program Office the prioritized risks and proposed mitigation strategies.
6. Implement mitigation strategies that have the concurrence of the DSMS Operations Program Office. Should a concurred-with risk require contract action to provide adequate mitigation resources, consult with the CTM and Contracting Officer.
7. Document the outcome of actions taken—whether positive or negative—for future “lessons learned.”

## 1.7 Training and Certification Program

At a minimum, the contractor will establish a program to train and certify the personnel performing the following functions:

- Link Controller

- Tracking Support Specialist
- Operations Chief
- Mission Support Engineer
- Test Engineer
- Maintenance Technician

In support of this task, the Contractor shall:

1. Establish and conduct training programs
2. [At a minimum, certify personnel performing the following functions: Link Controller, Tracking Support Specialist, Operation Chief, Mission Support Engineer, Test Engineer, Maintenance](#)
3. Maintain training records.
4. [Identify any other positions that require certification.](#)

## 1.8 Contract Performance Metrics

The Contractor will provide a performance measurement system that measures, in two specific areas, the level of performance in executing the tasks (that is, the contract statement of work [SOW]) in this TDD:

- Management, technical, and cost performance
- Response to the DSMS Operations Program Office areas of emphasis (AoEs)

These metrics will correlate to the contract SOW performance expectations, contract SOW standards of excellence, and the AoE issued by the CTM before to each performance-evaluation award-fee period.

In support of this task, the Contractor shall:

- Maintain and report technical performance metrics, in accordance with M021, Performance Metrics, as described in the CDRL.
- Maintain and report the status of the AoEs, in accordance with M021, Performance Metrics, as described in the CDRL.



## 2 GOLDSTONE DEEP SPACE COMMUNICATIONS COMPLEX OPERATIONS

---

The Goldstone Deep Space Communication Complex (GDSCC) is one of three tracking complexes that constitute the Deep Space Network (DSN). About 35 miles from Barstow, it is located entirely within the confines of the Fort Irwin military reservation (See Appendix D, GDSCC Map). The GDSCC encompasses 13,316 hectares, with elevations ranging from 950 to 1085 meters above sea level.

The GDSCC has five operational antenna sites: Apollo, Gemini, Mars, Uranus, and Venus. It also has two decommissioned antenna sites: Mojave and Pioneer. Except for the water storage tank located near the Pioneer site, these decommissioned sites are not part of this contract.

The Mars site includes the signal-processing center (SPC-10). The SPC-10 is the communications hub that processes signals to and from spacecraft, and monitors and controls antenna, telemetry, command, and radio-metric ground subsystems. Acquired spacecraft data are routed via a ground communication system to the Space Flight Operations Facility (SFOF) at JPL and subsequently to project operations control centers (POCCs) worldwide. The Contractor will operate and maintain the equipment at the SPC-10.

The SPC-10 is connected to the front-end areas at GDSCC by cable, local area network (LAN), and fiber-optic communications links. The front-end areas are deep space stations (DSSs) designated DSS-14, DSS-15, DSS-16, DSS-24, DSS-25, DSS-26, and DSS-27. DSS-16 can also function in a stand-alone mode utilizing its own data processing equipment. (DSS-12 and DSS-17 are decommitted from DSN operations; DSS-23 and DSS-28 are mothballed and in caretaker status.) Refer to Deep Space Mission System (DSMS) Document 810-005, *DSMS Telecommunications Link Design Handbook*, for the location of these various facilities at the GDSCC. The Contractor will operate and maintain the equipment at the front-end areas.

The Emergency Control Center (ECC) is at the Echo site, G-26. It houses DSOCC and flight-project data-processing equipment. The Contractor will maintain the ECC and activate it upon DSMS management request.

The front-end areas consist of hydraulically and electrically driven, two-axis rotational structures that are attached to large, parabolic-shaped reflectors, for concentrating and forming the RF beam. The structures also house the front-end microwave equipment consisting of microwave feeds, low-noise amplifiers, and RF processing equipment.

The GDSCC has seven antennas that are used in spacecraft-tracking operations, as shown in the following table of operational antennas at GDSCC:

**Operational Antennas at the GDSCC**

Size	ID	Type
70-meter	DSS-14	AZ/EL
34-meter	DSS-15	high-efficiency (HEF)
34-meter	DSS-24	beam waveguide (BWG)
34-meter	DSS-25	BWG
34-meter	DSS-26	BWG
34-meter	DSS-27	high speed beam waveguide (HSB)
34-meter	DSS-13	BWG (only used for research and development (R&D) of DSN technologies and high-power-transmitter development and testing)
34-meter	GAVRT <sup>1</sup>	STD (Outreach only)
26-meter	DSS-16	X/Y

1. Goldstone–Apple Valley Radio Telescope

GDSCC has five antennas that are currently not used in tracking, R&D, or the outreach program:

- The 9-meter antenna at the Apollo site, designated DSS-17. This antenna is decommissioned.
- The 11-meter space very-long-baseline-interferometry (SVLBI) antenna at the Apollo site, designated DSS-23. This antenna is decommissioned and in caretaker status, awaiting its final disposition.
- The antenna at the Mojave site (decommissioned). Although the antenna and facilities are not included in this contract, Mojave site security is included.
- The antenna and facilities at the Pioneer site, designated DSS-11. Except for the water tank, this site is decommissioned and is not included in the contract.
- The 34-meter HSB antenna at the Gemini site, designated DSS-28. This antenna was never operational and is in caretaker status.

The GDSCC buildings under this contract include 75 that are occupied by Contractor personnel and 39 that are used for storage or are empty. These buildings have an area of 16,516 m<sup>2</sup>.

The GDSCC is accessed by one of two roads: NASA Road and Goldstone Road. From these roads, access roads lead to the sites (from NASA Road to Gemini and Venus; from Goldstone Road to Echo, Apollo, Pioneer, Uranus, and Mars). The Contractor will be responsible for maintaining 27 miles of roadway.

Southern California Edison (SCE) provides the 33-kilovolt commercial power feed to the GDSCC. The GDSCC has two power plants: one at Echo (with 3,000-kilowatt diesel-generator capacity) and one at Mars (with 6,000-kilowatt

diesel-generator capacity). The Contractor will be responsible for maintaining and operating the GDSCC power plants and associated power grids.

Fort Irwin provides water to the GDSCC pump house—the only GDSCC building outside of GDSCC boundaries that the Contractor will maintain. The water supply system feeds:

- The 1,325,000-liter water-storage tank at Venus
- The 670,000-liter water-storage tanks at Apollo, Echo, Mars, and Venus
- The 670,000-liter emergency water-storage tank at Pioneer
- The 682,000-liter fire-protection-only water-storage tank at Mars

The Contractor will also be responsible for a Class-III landfill at the Echo site and four oxidation ponds: two at Echo and two at Uranus.

## 2.1 Deep Space Communications Complex Management

This task addresses the overall management of operations and maintenance at the GDSCC. The Contractor will be responsible for the performance of all of the tasks described in this document.

The Contractor will provide at least the following:

- Radio frequency coordination
- Site security
- Safety and health compliance
- Environmental compliance
- Energy and water management
- Intracomplex communications
- Support services
- Outreach
- Fort Irwin interface
- Airspace coordination
- Real-time operations
- Antenna/mechanical maintenance
- Technical systems maintenance
- Facilities and infrastructure maintenance
- Advanced systems operations and maintenance
- Technical services
- Planning and management reporting
- Performance measurement
- Subcontract management
- Procurement
- Property management
- Information management
- Configuration management
- Workmanship assurance
- Personnel management

- Other functions deemed necessary by the Contractor to manage this contract

The Contractor must integrate the organization at the GDSCC to ensure the scheduling, performance, reporting, and completion of all required tasks.

In support of this task, the Contractor shall:

1. Account for the operation of the GDSCC, including schedule, cost, and performance of all the tasks described in this document.
2. Establish, document, and implement processes for establishing a close working relationship with CDSCC and MDSCC, sharing lessons learned.
3. Integrate all GDSCC functions and activities, to ensure the timely completion of all tasks.
4. Work closely with and respond to the DSMS Operations Program Office and Contract Technical Manager (CTM) for assignment of Contractor resources and/or DSN assets to meet the short-term demands of any additional or accelerated task requirements levied on the DSN.
5. Establish, document, and implement Contractor processes to improve performance, reduce cost, and increase customer satisfaction.
6. Be responsible for the conduct and performance of Contractor personnel.
7. Perform and/or manage the following:
  - a. Radio frequency coordination
  - b. Site security
  - c. Safety and health compliance
  - d. Environmental compliance
  - e. Energy and water management
  - f. Intracomplex communications
  - g. Support services
  - h. Outreach
  - i. Fort Irwin interface
  - j. Airspace coordination
  - k. Real-time operations
  - l. Antenna/mechanical maintenance
  - m. Technical systems maintenance
  - n. Facilities and infrastructure maintenance
  - o. Advanced systems operations and maintenance
  - p. Technical services
  - q. Planning and management reporting
  - r. Performance measurement
  - s. Subcontract management
  - t. Procurement

- u. Property management
- v. Information management
- w. Configuration management
- x. Workmanship assurance
- y. Personnel management
- z. Other functions the Contractor deems necessary to manage this contract

### 2.1.1 Radio Frequency Coordination

Because of their extreme sensitivity, GDSCC antennas are susceptible to radio frequency interference (RFI). The likelihood of such interference is increased by nearby electronic activities supporting warfare test and training.

Because of the criticality and intensity of both National Aeronautics and Space Administration (NASA) and military operations, spectrum use in the Mojave Desert is actively coordinated among all affected parties. To address the unique demands of this coordination effort, the Department of Defense (DOD) and NASA have formed the Mojave Coordination Group (MCG). The group is cochaired by the DOD and the Jet Propulsion Laboratory (JPL), with membership from all the military bases and weapons labs in the area, the GDSCC, and the Federal Aviation Administration (FAA). Via the Mojave Coordination Agreement, procedures are established so that, when properly coordinated, military and GDSCC activities will not interfere with one another.

In support of this task, the Contractor shall:

1. Comply with the Memorandum of Understanding (MOU) between the DOD and NASA for Compatible Operations in the Mojave Desert Area ("Mojave Coordination Agreement").
2. Actively participate in frequency and RFI coordination, RFI prediction and analysis, and spectrum surveillance.
3. Perform routine radio frequency coordination:
  - a. Identify DSN Class-1 and Class-2 events in coordination with JPL Telecommunications and Mission Support (TMS) Managers and Contractor Mission Support Engineers, and notify NASA and DOD offices of RFI issues.
  - b. Provide a weekly GDSCC schedule to the Western Area Frequency Coordinator at Pt. Mugu.
  - c. Provide periodic briefings to DOD personnel about GDSCC activities, capabilities, and susceptibility to RFI.
  - d. Represent GDSCC operations at regular and ad hoc MCG meetings.
4. Perform special-case interference coordination:
  - a. Represent the GDSCC at special planning and evaluation meetings at JPL, Edwards, the FAA, or elsewhere, as requested by the JPL Spectrum Manager or Contractor Mission Services Engineer.

- b. Provide GDSCC schedules and related data as requested by agencies responsible for planning potential-interference scenarios.
  - c. Perform RFI analysis, monitor events for occurrence of RFI, and provide analytical reports of results.
5. Perform DSN RFI prediction and analysis in support of routine and critical mission event planning:
  - a. Perform RFI studies for Mission Event Readiness Reviews (MERRs), before critical spacecraft events.
  - b. Perform RFI studies, before anticipated RFI events:
    - i. A deep-space mission interfering with another deep-space mission
    - ii. An Earth orbiter interfering with a deep-space or high-Earth-orbit (HEO) mission.
    - iii. A launch vehicle interfering with a deep-space or HEO mission.
6. Provide RFI prediction for special events to Contractor mission services engineers and to SPC-10 personnel.
7. Investigate, coordinate, analyze, and report RFI occurrences:
  - a. Identify GDSCC–external RFI, and notify the source to terminate transmission.
  - b. Identify GDSCC–internal RFI, notify the on-duty operations supervisor, and resolve the problem.
  - c. Investigate any RFI that cannot be immediately identified.
  - d. Conduct spectral measurements of potential RFI sources.
  - e. Record RFI event closeouts for all RFIs, including lessons learned for the RFIs in the DSN band.
  - f. Compile, analyze, and publish an RFI summary report every 12 months. Due at the end of January, this report includes event occurrences and three-year-trend analysis with statistics and explanations.
8. Perform spectrum surveillance:
  - a. Monitor spectrum activities around the GDSCC in the DSN and shared bands
  - b. Investigate events detected by the Radio Frequency Surveillance System (RFS) in the DSN band.
  - c. Identify sources of threatening events and coordinate to resolve them.
  - d. Maintain a trend-record database of detected events.
  - e. Maintain the RFS equipment, including the antenna station and remote monitoring terminal.
  - f. Advise the JPL Spectrum Manager about needed upgrades to the RFS.
9. Provide NASA–JPL frequency management support:
  - a. Represent the GDSCC at JPL–GDSCC spectrum management meetings.

- b. Ensure that all radiation from all GDSCC transmitters are in accordance with National Telecommunications and Information Administration (NTIA) authorizations provided by the JPL Spectrum Manager.
- c. Maintain and update the frequency assignment database for the GDSCC.

This task has the following special provision:

- 1. The RFI Coordination Manager shall have a “secret” clearance and in-depth knowledge of radio frequency theory, as described in Appendix J, Contractor Staff Roles.

### 2.1.2 GDSCC Site Security

The GDSCC is part of the minimum essential infrastructure that NASA considers necessary for accomplishing its mission. Because of its remote location, the value of the infrastructure and equipment, the number of resident and nonresident contractor and JPL employees, and the frequent tourist visitors to the site, the Contractor will establish and maintain a comprehensive security system. The system will include passive security (access control, fencing, etc.) and active security (guards, patrols) to ensure access control, equipment security, property security, and rapid response to reported and suspected security incidents.

Key interfaces have been established to ensure cooperation, coordination, and information exchange with NASA–JPL Security and with public security providers at the local, state, and federal levels. Such providers include the San Bernardino County Sheriff, the California Highway Patrol, the Fort Irwin Provost Marshal, and the Federal Bureau of Investigation (FBI).

In support of this task, the Contractor shall:

- 1. Provide security for the GDSCC.
- 2. Establish a security system that conforms to NASA, JPL, and homeland security requirements.
- 3. Develop and document a security plan that satisfies the following:
  - a. NASA Procedures and Guidelines (NPG) 1620.1, *Security Procedures and Guidelines*, especially Chapter 8, “NASA Minimum Essential Infrastructure Protection Program,” subject to approved NASA Code X waivers
  - b. NPD 1600.2, *NASA Security Policy*
  - c. Applicable Presidential Decision Directives
  - d. National Industrial Security Program Operating Manual, DoD 5220.22
- 4. In its security plan, consider the remoteness of the GDSCC, including its location with respect to Fort Irwin and other military reservations, the size of the facility, and agreed-to NASA Resource Protection (NRP) waivers.

5. Control access to the GDSCC, including
  - a. Authorize and log visitor access.
  - b. Coordinate all foreign national visit requests with JPL.
  - c. Escort visiting foreign nationals without National Agency Check (NAC).
6. Interface with the Fort Irwin Provost Marshal's Office to arrange transit for visitors and foreign nationals.
7. Provide security guard services.
8. Provide site and building security that controls and records building access.
9. Provide site passive security in conformance with the previously referenced documents.
10. Provide reporting and logging processes, procedures, and mechanisms for security-related incidents, including unauthorized access, unauthorized removal of or damage to equipment, threats, and civil code violations.
11. Interface with JPL Security to ensure continued compliance with current homeland security and NRP security requirements and status.
12. Interface with JPL Security and the Fort Irwin Provost Marshal's Office to keep force condition levels consistent with DOD's and NASA's.
13. Submit security incident reports to JPL Security and the CTM, as described in M012, Security Management Plan, in the CDRL.
14. Submit to NASA/JPL audits or assessments of security plans and capabilities, as requested and/or scheduled.

### 2.1.3 Safety and Health Compliance

Many of the activities at the GDSCC involve large, mechanical, moving structures; electromagnetic radiation; and hazardous materials. The size and remoteness of the GDSCC require extended travel with its inherent increase in risk. The remoteness of GDSCC and its minimal emergency medical capabilities may also contribute to health and safety risks. Because of these risks, the Contractor must establish and manage a safety-and-health program to protect personnel and equipment. The Contractor must also actively ensure employee compliance with the program and provide regular status and incident reports.

Because various contractors and JPL employees, as well as Contractor employees, require access to the GDSCC, it is considered a multi-employer worksite. Therefore, the Contractor is responsible for ensuring the safety and health not only of its own employees, but also of its subcontractor employees, JPL employees, JPL's contractor employees, and all other visitors to the GDSCC and Contractor facilities.

The Contractor will also take measures to prevent damage to or destruction of all material, equipment, and facilities at the GDSCC.



In support of this task, the Contractor shall:

1. Develop and comply with an approved Safety, Health, and Environmental Plan (M009), as described in the CDRL. The plan shall encompass:
  - a. Personnel training
  - b. Accident prevention, investigation, and reporting
  - c. Emergency preparedness
  - d. Fire prevention and suppression
  - e. Procurement of safety and fire suppression supplies
  - f. Confined-space entry
  - g. High-voltage electrical safety
  - h. Lockouts, tagouts, and blockouts
  - i. Electromagnetic radiation and radio-frequency hazards
  - j. Rotating machinery hazards
  - k. Hazardous and toxic substances
  - l. High-fluid-pressure hazards
  - m. Pressure vessels and systems
  - n. Dangerous obstructions
  - o. Evacuation of injured personnel from antennas and other high structures
2. As part of the safety and health plan, develop, document, and implement specific safety plans for each work site.
  - a. The plan shall address:
    - i. Personnel responsibilities for safety and health
    - ii. Identification, evaluation, and abatement of workplace hazards
    - iii. Safe work practices and procedures
    - iv. Plan communication, enforcement, training, and record-keeping processes
    - v. Accident/incident investigation procedures
  - b. The plan shall strongly emphasize injury and illness prevention
  - c. The plan shall establish an effective first-aid and cardiopulmonary-resuscitation (CPR) training program.
  - d. The plan shall specify responses to natural disasters such as earthquakes, fires, floods, and high winds.
3. As part of the safety and health plan, develop, document, and implement an Injury and Illness Prevention Program that complies with the California Code of Regulations (CCR), Title 8, *General Industrial Safety Orders*, as applicable.
4. Comply with JPL D-560, *JPL Standard for Systems Safety*, as applicable.
5. Develop, document, approve, and enforce engineering-change safety plans for Contractor-performed work.

6. Approve and enforce safety plans for work performed by subcontractors, JPL, and JPL subcontractors.
7. Provide the plan to the cognizant JPL Office 530 managers and to the CTM, for approval.
8. Develop and implement procedures and provide trained personnel to establish and maintain an emergency response team that shall prevent, control, or minimize damage and injury from hazardous conditions and mishaps.
9. Comply with all JPL and NASA planning and reporting requirements for injuries, facility damage, property/equipment damage and close calls.
10. Ensure that the plan is implemented and maintained by a Certified Safety Professional (CSP).
11. Develop and implement fire protection procedures, emphasizing the use of fire suppression or containment equipment, procedures, and personnel training to prevent fire or contain and minimize fire damage.
12. Maintain an interface with Fort Irwin medical and fire-fighting authorities to ensure continued emergency medical evacuation and fire-fighting support.
13. Ensure that National Fire Protection Association (NFPA) and NASA requirements for fire protection are followed.
14. Communicate its safety and health plans and requirements to its employees.

This task has a special provision:

1. A CSP shall implement and maintain the safety and health plan. The CSP shall:
  - a. Maintain all Cal/OSHA–required record keeping and documentation.
  - b. Ensure issuance and maintain safety oversight of the required qualifications and certifications for all operators of heavy equipment.
  - c. Maintain Cal/OSHA certifications, requirements, and testing records, along with documentation for all antenna hoists and cranes, pressure vessels and systems, electrical systems, radio-frequency equipment, lasers, and any other equipment per Cal/OSHA requirements.
  - d. Report injuries, illness, facility damage, property/equipment damage, and close calls to JPL and NASA following the policy and procedure in NASA Policy Document (NPD) 8621.1, *NASA Mishap and Close-Call Reporting, Investigation, and Recordkeeping*.

#### **2.1.4 Environmental Compliance**

The GDSCC is in a sensitive environment in the Mojave Desert. In the course of operating and maintaining the hardware in the facilities, personnel regularly use and handle hazardous materials. These activities are subject to stringent local, state, and federal environmental regulations. The Contractor will comply

with all environmental regulations and regularly report on the status of its compliance with them.

In support of this task, the Contractor shall:

1. Establish an environmental-management plan for ensuring compliance with environmental regulations during all aspects of the Contractor's work at the GDSCC.
2. Comply with all applicable federal, state, and local regulatory requirements, and with other government policies:
  - a. NPD 8500.1 *NASA Environmental Management*
  - b. NPG 8820.3 *Pollution Prevention*, subject to state and local requirements for reporting hazardous material changes. Those requirements should meet or exceed the federal schedules found in Chapter 6 of the NPG.
  - c. NPG 8830.1 *Affirmative Procurement of Environmentally Preferable Products*.
  - d. NPG 8580.1, *Implementing The National Environmental Policy Act And Executive Order 12114*
  - e. The Resource Conservation and Recovery Act (RCRA), the Clean Air Act, the Endangered Species Act, and the National Historic Preservation Act.
  - f. Executive Orders. Executive Orders applicable to work performed under this Contract are set forth in Appendix C, Applicable Documents.
3. For contractor tasks that may adversely affect the environment, comply with the NPG 8580.1:
  - a. Submit JPL Form 39 to the cognizant JPL Office 530 manager and to the CTM, for approval.
  - b. Implement the task according to the approved plan.
4. In coordination with the JPL Environmental Affairs Office and Office 930, interact with state, federal, and local environmental-regulatory agencies.
5. When seeking equipment permits from the Mohave Desert Air Quality Management District, coordinate with the JPL Environmental Affairs Office and Office 930.
6. Establish procedures for the handling and reporting of hazardous materials and waste, including personnel training and certification.
  - a. Do no work on known asbestos-containing materials, asbestos-contaminated materials, materials that might release polychlorinated biphenyls (PCBs), chlorofluorocarbons (CFCs), ozone depleting substances (ODSs), radioactive materials, radioactive sources, or oil containing PCBs or lead, without prior approval of the JPL Environmental Affairs Office.

- b. Notify the JPL Environmental Affairs Office and the CTM of known use and disposal of hazardous material, including asbestos contamination, PCB equipment, lead-based paint, CFC chillers, ODSs, and radioactive sources.
  - c. Generate and update records of hazardous material notifications for discovery, disturbance, or removal of hazardous material.
  - d. Dispose of hazardous material in a manner approved by the JPL Environmental Affairs Office.
  - e. Provide monthly reports to the JPL Environmental Affairs Office and to the CTM, of the disposal of the waste, including type, date, quantity, location, doing organization, and responsible agency.
  - f. Certify employees directly involved in hazardous material handling, storage, and shipping in accordance with federal, state, and local laws and regulations.
7. Establish policies for reducing the emission and use of ODSs:
  - a. In the storage and use of ODSs, comply with Executive Order 12843, *Procurement Requirements and Policies for Federal Agencies of Ozone-Depleting Substances*.
  - b. Provide monthly reports to the JPL Environmental Affairs Office and the CTM of the status of the inventory of ODSs.
8. Wear or use personnel protective equipment (PPE) appropriate to the task being performed.
9. Establish procedures for keeping Material Safety Data Sheets (MSDSs) current for all materials used.
10. Adhere to recycling program policies and procedures, as required by the Fort Irwin MOU.
11. Use trained personnel to clean up any hazardous material spills at the GDSCC. Immediately report these incidents to the CTM and to the JPL Environmental Affairs Office.

This task has a special provision:

1. The work shall be managed by a Registered Environmental Assessor (REA)

## **2.1.5 Energy and Water Management**

The Contractor will provide energy and water management.

In support of this task, the Contractor shall:

1. Establish and enforce programs to acquire, conserve, and report energy usage of government-owned facilities (GOF) at the GDSCC.
  - a. Comply with the energy efficiency and water conservation goals and requirements of the National Energy and Water Conservation Policy Act, 42 USC 8251-8287, as amended by the Energy Policy Act of

- 1992, P.L. 102-486; and of Executive Order 13123, Greening the Government Through Efficient Energy Management.
- b. Set annual goals to reduce building energy usage per gross square foot from the FY 1985 baseline. The annual goals shall be indexed to the federal goals to achieve a 30 percent reduction by the end of fiscal year (FY) 2005 and a 35 percent reduction by the end of FY 2010.
  - c. Set annual goals to reduce the utilized gross square footage of energy-intensive facilities. The annual goals shall be indexed to the federal goals, to achieve a 20 percent reduction by the end of FY 2010.
2. Procure all required energy to operate and maintain the GDSCC. This includes:
    - a. All electrical power from an outside vendor
    - b. The petroleum, oil, and lubricants (POL) necessary to operate and maintain local energy-generation facilities
  3. Maintain monthly records of energy costs and usage for the current year and previous three years.
  4. Conduct comprehensive energy conservation audits of approximately 10 percent of facility gross square footage each year.
    - a. Propose cost-effective energy conservation measures to the DSMS Operations Program Office.
  5. Provide to the DSMS Operations Program Office:
    - a. Quarterly energy and water consumption reports
    - b. Annual Office of Management and Budget Circular A-11, Energy and Transportation Efficiency Management, budget exhibits
    - c. Annual assessment report of energy management progress
  6. Minimize the life cycle cost of new and renovated facilities by utilizing sustainable design and construction methods, where cost effective:
    - a. Comply with either the current Federal Energy Building Code 10 CFR 434 or the State of California Title 24 Energy Efficiency Code, as directed by JPL, for all facility design and construction work performed by the Contractor.
  7. Prepare all annual and special energy and environmental reports as required by the NASA Energy and Environmental Management Division (Code JE).

### 2.1.6 Intracomplex Communications

Local (intracomplex) communications at the GDSCC consist of multiple systems, including:

- An extensive (conventional) telephone system (400 sets)
- Portable radio transceivers (including a base station and antennas)

- An administrative LAN

These communication systems support administrative functions, operational-activity coordination, antenna maintenance, and other maintenance. The telephones and radios are also required for the safety of personnel.

In support of this task, the Contractor shall:

1. Maintain the communications equipment, supporting infrastructure, and associated test equipment.
2. Perform logistics and maintenance support for all installed components, as required to maintain or exceed an overall availability of 99.9%.
3. Operate, administer, and maintain administrative LAN equipment (hubs, switches, and routers), associated system software, and operational configurations.
4. Maintain records of hardware and other system failures, and recommend replacement or upgrades, as required.

### **2.1.7 Information Management**

Information management at GDSCC consists of managing the following information equipment or systems:

- Administrative firewall, to protect the administration and science networks from intrusions
- Intrusion detection equipment
- Email servers for administrative, mission support, and DSN-wide operational messaging

In support of this task, the Contractor shall:

1. Administer information systems
2. Perform logistics and maintenance for all installed components.

### **2.1.8 Support Services**

Support services consist of sanitation/custodial services, landscaping services, food services, transportation, and heavy equipment.

#### **2.1.8.1 Sanitation/Custodial Services**

The Contractor will provide sanitation services for a clean working environment for personnel and a clean operating environment for equipment. Pursuant to an MOU between the DOD and NASA, the GDSCC disposes of trash at Fort Irwin.

In support of this task, the Contractor shall:

1. Maintain indoor and outdoor environments at the GDSCC that protect personnel and equipment.
2. Provide a working environment that promotes personnel safety, health, morale, and productivity.
3. Comply with all federal, state, and local laws and regulations governing sewage and solid waste disposal.
4. Provide for trash removal and disposal:
  - a. Every day, collect trash and recyclables, place them in the provided containers, and transport them to Fort Irwin.
  - b. Recycle according to the MOU.
5. Provide sewage system maintenance.

#### **2.1.8.2 Landscaping Services**

In support of the Landscaping Services task, the Contractor shall:

1. Ensure that the outside areas present a neat, clean, and pleasing appearance.

#### **2.1.8.3 Food Services**

At the GDSCC Echo site is a cafeteria with commercial-sized cooking surfaces and ovens, a commercial-sized dishwasher, cooking utensils, pots and pans, serving trays, serving plates, glasses, and silverware. The Contractor will provide food services at the Echo Site and make provisions for providing food services at all remote sites.

In support of this task, the Contractor shall:

1. Provide food service for personnel and visitors at the GDSCC.
2. Operate the food service in accordance with all federal, state, and county regulations governing food service and associated sanitation.
3. Provide food service at the remote work locations by delivering food from a central location to the remote locations and/or by providing vending machine service at the remote locations.

#### **2.1.8.4 Transportation**

Because of the distance between the various work sites within GDSCC, the Contractor will provide ground transportation for personnel and materiel. The Contractor will also operate an emergency response vehicle.

The Army will provide ambulance service to Weed Army Hospital at Fort Irwin. In life-threatening circumstances, the Army will provide air ambulance services from GDSCC to Weed Army Hospital or to a civilian medical facility, based on the orders of the Medical Officer-in-Charge (OIC).

In support of this task, the Contractor shall:

1. For material and all Contractor personnel, provide transportation between the various GDSCC work sites.
2. For JPL personnel, provide vehicles for transportation between the various GDSCC work sites.
3. For all personnel, provide transportation between Echo and the GDSCC airport.
4. Ensure that all vehicle operators on the GDSCC—including operators of GSA vehicles—comply with all traffic laws, rules, and regulations, especially those imposed by the Army at Fort Irwin.
5. Operate an emergency response vehicle (owned by the GSA) at the GDSCC. The General Services Administration (GSA) provides all maintenance services for GSA vehicles.

#### **2.1.8.5 Heavy Equipment**

JPL will furnish some GFE heavy equipment to the Contractor. Because of the nature of the work at the GDSCC (elevated work locations on antennas, roadwork, heavy lifting, etc.), this equipment may not suffice for all work performed on site. In such cases, the Contractor will provide the necessary heavy equipment.

The Contractor shall:

1. Determine heavy equipment requirements and, when necessary, secure the required heavy equipment for as long as required.
2. For the life of the contract, provide a heavy-lift capability to height of at least 150 feet.

#### **2.1.9 Outreach Program Activities and Products**

Outreach activities will be included in the contract. One effective Contractor outreach activity at the GDSCC is the public tour. Another is acquainting visitors in the scientific and technical community with DSN activities.

In support of this task, the Contractor shall:

1. Coordinate and schedule GDSCC visitor tours.
2. Conduct visitor tours, including presentations and site visits.
3. Conduct open houses, in coordination with JPL.
4. Help develop and maintain outreach exhibits at the GDSCC.
5. Represent the GDSCC to the local community.
6. Ensure that all publicly released information is approved by the JPL Public Affairs Office.
7. Provide a monthly narrative report of outreach activities to the JPL Interplanetary Network Directorate (IND) Outreach Coordinator.



8. Enter into the NASA outreach-tracking database, the Education Program Data Collection and Evaluation System (EDCATS), the number of visitors, venues of off-site events, participants present at off-site events, and other relevant details.

#### **2.1.10 DOD Interface**

MOUs among NASA, JPL, and the DOD govern the interagency cooperation for:

- Road repair
- RFI protection
- Military Police (MP) assistance
- Fire fighting
- Ambulance services
- Emergency medical services
- Water
- Solid-waste disposal
- Recycling

Fort Irwin provides the central water supply to the GDSCC by allowing the GDSCC water pump house, outside the GDSCC boundary on Fort Irwin proper, to pump water from Fort Irwin's water storage tanks. JPL pays for the electricity used at the GDSCC pump house and for the water purchased from the Army to supply the GDSCC.

The Naval Weapons Training Center (NWTC) China Lake and Edwards Air Force Base (AFB) have installed equipment to support the Goldstone National Training Center (NTC) Inter-Range Microwave System (GNIMS) at the G-100 location, near Apollo. Although no specific support activities are required of the Contractor, the Contractor will need to periodically provide NWTC and Edwards AFB personnel with access to the site.

The NWTC is laying fiber-optic lines from the western boundary of the GDSCC through the Echo site, to the NTC. These lines will become the primary communications link between the NTC and the NWTC; GNIMS will become the backup link.

The Department of the Army is expanding the Fort Irwin NWTC land area to the west and south of the GDSCC. The Contractor will be involved in assessing the environmental impact statement (EIS).

In support of this task, the Contractor shall:

1. Establish a working interface with the various Fort Irwin offices and meet with them at least quarterly.
2. Report to the CTM any issues arising between the Army and the GDSCC that could adversely affect GDSCC operations or that could jeopardize the relationship between the Army and NASA or JPL.

3. Help NASA and JPL offices interface with Fort Irwin, at the request of the CTM.
4. Participate in meetings that review MOUs and cooperation among NASA, JPL, and various defense agencies.
5. Provide technical assistance to Army, Navy, or Air Force personnel operating within the GDSCC boundaries. Coordinate discrepancies or issues with the CTM.

### **2.1.11 Airspace Coordination**

The antennas at Goldstone are capable of radiating high-power microwave signals ranging from 4 kW to 500 kW. High-power radiation can be hazardous to military and civilian aircraft operating in nearby airspace. Because this airspace is heavily used by military and commercial flights, its use is coordinated via the MCG, described in Section 2.1.1. The Contractor must coordinate with the MCG any high-power-radiation activities at the GDSCC, especially the use of the Goldstone Solar System Radar (GSSR).

In support of this task, the Contractor shall:

1. Coordinate over-flights of the GDSCC, per DOD requests.
2. Investigate unauthorized over-flights and notify DOD flight operations of them.
3. Prepare maps, pointing angles, time-period, and other specifics for each GSSR track, as necessary to obtain approval for high-power radiation.
4. Issue high-power radiation authorization to the SPC-10.
5. Coordinate high-power radiation for spacecraft emergencies.
6. Represent the GDSCC at monthly R2508 Complex Control Board meetings convened by the FAA and present forecasts of high-power transmitter usage to the Central Coordinating Facility (CCF).
7. Investigate unauthorized high-power radiation and report it to the CCF and the JPL Spectrum Manager (with time period, pointing angles, power, frequency, and bandwidth).
8. Train GDSCC real-time operations personnel on high-power transmitter operation that could compromise safety or lead to the violation of frequency and airspace authorizations.
9. Coordinate GDSCC airport use.

## **2.2 Real-Time Operations**

The Contractor supports the DSN by providing 24-hour-a-day, seven-day-a-week real-time operations and system administration at the GDSCC. The primary functions of GDSCC real-time operations are to:

- Acquire telemetry from spacecraft
- Transmit commands to spacecraft

- Generate radio-metric data consisting of angle, range, Doppler, and very-long-baseline interferometry (VLBI) data
- Generate radio-science data
- Operate the GSSR
- Provide real-time monitoring of data
- Be the focal point for all on-site activities
- Administer local systems

Real-time operations are conducted in the SPC-10, as described in the introduction to Section 2. These operations may require real-time maintenance, as described in sections 2.3 and 2.4.

GDSCC real-time operators (“Link Controllers”) remotely monitor and control DSS subsystem elements. These elements acquire and process telemetry data, transmit commands, generate radio-metric and radio-science data, and monitor the performance of the DSS. The Link Controllers monitor the performance of each spacecraft-dependent data-processing link. They also coordinate all spacecraft-specific activities with flight-project control teams, with Tracking Support Specialists (TSSs), and with the Operations Chief at the Network Operations Control Center (NOCC).

The Link Controllers maintain real-time-operations activity logs, write discrepancy reports, and maintain station logs. They also support DSN data-systems development personnel during the testing of new capabilities, and they participate in the testing of new or modified capabilities.

Real-time operations personnel also monitor smoke alarms, fire alarms, emergency response communications, GDSCC security-guard communications, and communications with the NASA airplane. They are also the focal point for alerting emergency response teams and Fort Irwin emergency response units.

In support of this task, the Contractor shall:

1. Perform real-time operations in accordance with DSN standard operating procedures (SOPs), and with DSN-provided and Contractor-provided operations documents.
2. Operate GSSR and radio-astronomy equipment.
3. Support the testing of new or modified capabilities.
4. Reallocate GDSCC resources in real time, in response to scheduling changes or spacecraft emergencies.
5. Perform system administration, including real-time administration.
6. Alert Fort Irwin and GDSCC emergency-response teams, and coordinate their response.
7. Perform Level-1 maintenance.
8. Monitor activities for RFI.

9. Activate the Emergency Control Center (ECC)
10. Attend operations working groups and technical interchange meetings at the GDSCC, Pasadena, and the overseas complexes.

This task has a special provision:

1. Real-time operations staff shall be certified in real-time operations, as described in Section 1.7.

## 2.3 Antenna/Mechanical Maintenance

Along with the antennas of the Canberra Deep Space Communication Complex (CDSCC) and the Madrid Deep Space Communication Complex (MDSCC), the antennas at the GDSCC are the most valuable assets in the DSN: without them, the DSN would not exist. Their availability, which must meet the high standards of DSN users and customers, is contingent upon how well the antennas and related mechanical components are maintained. When unusual findings are reported during antenna maintenance, engineers and technicians can determine maintenance needs, choose approaches to maintenance, or design engineering changes that extend the life of antennas, increase their performance, or meet as-built specifications.

The Contractor will be responsible for the maintenance and repair of the GDSCC antennas below:

- GAVRT (formerly DSS-12), a 34-meter standard telescope, operational for outreach activities
- DSS-13, a 34-meter antenna with BWG, operational for R&D
- DSS-14, a 70-meter, operational antenna
- DSS-15, a 34-meter, HEF, operational antenna
- DSS-16, a 26-meter, operational, X/Y antenna
- DSS-24, a 34-meter, operational, BWG antenna
- DSS-25, a 34-meter, operational, BWG antenna
- DSS-26, a 34-meter, operational, BWG antenna
- DSS-27, a 34-meter, operational antenna with HSB waveguide
- DSS-23, an 11-meter antenna, decommissioned from operational support. This antenna requires only custodial maintenance, that is, maintenance to ensure basic mechanical operation.
- DSS-28, a 34-meter, HSB waveguide antenna that has never been operational. This antenna requires only caretaker maintenance, that is, the protection of its exposed structural and mechanical surfaces.

This task addresses only the maintenance of nonelectronic equipment belonging to the Antenna Subsystem, that is, the maintenance of the structural, mechanical, and Cassegrain assemblies, along with the special tooling and integration that is required for this maintenance. To assist in the performance of this task, the Contractor will be provided with DSN maintenance standards, antenna specifications, and design drawings.

Maintenance tasks for these assemblies are further described in the sections following.

In support of this task, the Contractor shall:

1. Report all maintenance activities via a Computerized Maintenance Management System (CMMS).
2. Relay all unusual findings to operators, maintainers, and design engineers.
3. Implement engineering change orders (ECOs) for the antennas.

This task has a special provision:

1. The work shall be performed by antenna maintenance personnel as described in Appendix J, Contractor Staff Roles.

### **2.3.1 Structural Assembly**

The Contractor will be responsible for the maintenance and repair of the antenna Structural Assembly. The structural assembly consists of:

- Frame of structural steel, alloy steel, and some aluminum members, either bolted or welded together
- Concrete support pedestal under each frame

In support of this task, the Contractor shall:

1. Perform predictive and preventive maintenance on, and repair of, the antenna structural assemblies, to include:
  - a. Inspection, repair, and replacement, as necessary, of the protective coating
  - b. Inspection, repair, and replacement, as necessary, of the bolted and welded connections
  - c. Inspection and repair of structural members
  - d. Inspection, repair, and replacement, as necessary, of the concrete and grouting

### **2.3.2 Mechanical Assembly**

The Contractor will be responsible for the maintenance and repair of the antenna mechanical assembly. The mechanical assembly rotates the structural assembly in both elevation and azimuth. The mechanical assembly consists of:

- Wheels and tracks
- Elevation rotation components:
  - Elevation bearing
  - Elevation drive-gear reducers
  - Elevation bull-gear assemblies
  - Elevation drives (electrical and servohydraulic)
- Azimuth rotation components:
  - Rotational bearings (radial trucks and pintle bearings)
  - Azimuth drive-gear reducers

- Azimuth bull-gear assembly (70-meter and 11-meter antennas)
- Azimuth drive motors (electrical and servohydraulic)
- Azimuth hydrostatic bearing assembly (70-meter antenna)
- Azimuth wheel and track assembly
- Subreflector positioners
- Antenna hydraulic systems:
  - Hydraulic pumps
  - Hydraulic motors
  - Valves (pressure, reducing, relief, and servo)
- Cryogenic assemblies
- Other equipment

Maintenance of the mechanical assembly varies among the antennas:

- Servo hydraulic motors drive the 26-m and 70-m antennas, whereas electric motors drive the rest.
- The 70-m antenna rotates in azimuth on a hydrostatic bearing.
- The 34-m antennas rotate on a wheel-and-track system.

In support of this task, the Contractor shall perform predictive and preventive maintenance on, and repair of, the antenna mechanical assembly, to include:

1. Monitoring, inspection, lubrication, and repair of all mechanical systems
2. Monitoring, inspection, lubrication, and repair of all hydraulic systems
3. Monitoring, inspection, lubrication, and repair of all cryogenic assemblies

### **2.3.3 Cassegrain Assembly**

The Contractor will be responsible for the maintenance and repair of the Cassegrain assembly. This assembly provides each antenna with the capability to reflect RF energy into and out of the microwave feed systems. The Cassegrain system consists of the following:

- The main reflector surface (adjustable aluminum panels)
- The aluminum subreflector
- Reflective aluminum mirrors

In support of this task, the Contractor shall:

1. Clean, align, and repair the Cassegrain assembly components:
  - a. The main reflector surface
  - b. The aluminum subreflector
  - c. The aluminum mirrors

### **2.3.4 Special Tooling and Instrumentation**

Special tooling and instrumentation are used to support the monitoring, preventive maintenance, predictive maintenance, and repair of the structural, mechanical, and Cassegrain assemblies. The Contractor will be responsible for the maintenance and calibration, as required, of this tooling and

instrumentation, and the repair of the same when necessary. The special tooling and instrumentation consist of the following:

- Handling fixtures
- Strain gauges
- Measurement equipment
- Analytical equipment
- The hydrostatic bearing instrumentation (HBI) system

In support of this task, the Contractor shall:

1. Maintain special tooling and instrumentation
2. Calibrate, as required, special tooling and instrumentation, in accordance with NPD 8730.1, *Metrology and Calibration*.
3. Repair, as necessary, special tooling and instrumentation

## 2.4 Technical Systems Maintenance

In the Technical Systems Maintenance task, the Contractor will provide a maintenance capability that supports the implementation of new capabilities, supports the preventive and predictive maintenance programs, and increases the availability of GDSCC assets.

GDSCC technical systems include mechanical, electromechanical, hydromechanical, electric, RF, data processing, communications, voice, and electronic devices, both analog and digital. Equipment identified as “operational” in DSMS Document 820-061, *DSMS Subsystem, Configuration Items, and Responsibility Definition*, is maintained by the Contractor. Technical Systems Maintenance follows the requirements of JPL Document 814-007, *DSMS Maintenance Program*.

The Contractor will perform all three levels of corrective maintenance, as defined in Appendix B, Glossary. Maintenance will be provided 24 hours a day, seven days a week.

The Complex Maintenance Facility (CMF) provides for the test and repair of DSN equipment that cannot be tested or repaired at the deep-space communication complexes (DSCCs). The CMF provides repair, maintenance, and calibration for mechanical, electronic, and radio-frequency components. The CMF also provides a reference standards program traceable to the National Institute of Standards and Technology (NIST).

### **2.4.1 Goldstone Technical System Maintenance**

In support of the Goldstone Technical System Maintenance task, the Contractor shall:

1. Provide preventive maintenance and Level-1 and Level-2 corrective maintenance for all technical equipment at the SPC-10, the ECC, and GDSCC front-end areas.
2. Implement new and modified equipment.
3. Support the acceptance testing of new and modified capabilities.
4. Assist the tracking complexes in Canberra, Australia (CDSCC), and Madrid, Spain (MDSCC), including travel to support major implementations, upgrades, and downtime maintenance.
5. Provide custodial maintenance of the DSS-23 and DSS-28 antennas.
6. Provide systematic-error correction tables for use in antenna pointing models.
7. Provide to the DSMS Operations Program Office parametric data reports of equipment and software reliability, maintainability, restorability, and maintenance.
8. Provide technical support for design, system safety evaluation, modification, training, and problem resolution.

This task has a special provision:

1. The Contractor shall ensure that its maintenance personnel are trained and certified.

### **2.4.2 Network Maintenance Support**

In support of this task, the Contractor shall:

1. Provide a CMF that will provide depot level maintenance and repair for GDSCC and specialized maintenance and repair to all DSCCs.
  - a. Isolate and repair failures at the level of the lowest-replaceable element (LRE).
  - b. Troubleshoot, repair, maintain, calibrate, and test mechanical, electronic, and radio-frequency components
  - c. Repair, modify, test, and calibrate all test instruments at the GDSCC.
    - i. Maintain a database of all calibration records, in accordance with NPD 8730.1.
    - ii. Conform to ISO 9001-2000, *Quality Management Systems—Requirements*.
  - d. Operate and maintain a trend-analysis laboratory for predictive maintenance of mechanical and electrical equipment at the GDSCC.
    - i. Provide oil, vibration, thermographic, and ferrographic analysis on motors, pumps, and high-voltage devices.
    - ii. Collect baseline data.



- e. Repair at the CMF hydraulic system components from throughout the DSN that cannot be repaired at the DSS level. JPL will supply as GFE a large, motor-driven hydraulic supply pump and several hydraulic test stands.
- f. Within a clean environment at the CMF, operate a hydraulic test-and-calibration facility.
- g. Within a clean environment at the CMF, operate a special laboratory for the repair, test, and calibration of cryogenic RF components, including maser refrigerators, vacuum pumps and signal-waveguide couplers. JPL will provide, as government-furnished equipment (GFE), any special apparatus, such as helium leak detectors and tilt tables to simulate antenna movement in all axes.
- h. Establish and operate electronic repair capabilities in a laboratory environment. The laboratory shall contain all necessary equipment, workbenches, environmental control system, test instruments, procedures, technical library, production control system, and vendor repair support.
- i. Provide a capability to repair and calibrate RF modules.
- j. Maintain a Reference Standards Laboratory (RSL) with standards traceable to NIST. Calibrate the following standards against NIST standards and supply the calibrated standards to each DSCC annually:
  - i. DC voltage and current standards
  - ii. AC voltage and current standards
  - iii. Resistor standards
  - iv. Capacitor standards
  - v. Attenuation standards
  - vi. Phase standards
  - vii. Impedance standards
  - viii. Inductance standards
  - ix. RF power standards
  - x. Torque standard
  - xi. Fluid flow standard
  - xii. Pressure standard
  - xiii. Length standard
  - xiv. Mass standard
  - xv. Gas flow standard
  - xvi. Pressure standard
- k. Establish, maintain, and document a production control system.

- l. Establish and maintain a technical library containing current copies of applicable technical manuals and test procedures.
- m. Prioritize CMF repair and test activities, in accordance with current tracking commitments.

This task has the following special provision:

1. The Contractor shall ensure that its maintenance personnel are trained and certified to repair, modify, calibrate, and test the RF, electrical, electronic, and hydraulic equipment at the DSN.

## 2.5 Facilities and Infrastructure Maintenance and Construction/Modification

The Contractor will be responsible for maintaining all buildings and grounds at the GDSCC, except for the buildings at the Pioneer and Mojave sites, regardless of the corporate affiliations of the building occupants or contents.

The Contractor will be responsible for maintaining and operating the heavy equipment at the GDSCC.

The GDSCC infrastructure consists of:

- Buildings and towers
- A technical plant:
  - Heating, ventilation, and air conditioning
  - Plumbing
  - Electrical system
  - Power lines, power plant, diesel generators
  - Water supply
- Roads
- A septic system and oxidation ponds
- A drainage system
- The Echo Site Class-III landfill
- Storage yards
- An airport

Periodically, the Contractor will be involved in constructing new facilities or in modifying existing facilities. For minor projects for the construction of facilities (CoF) (i.e., those projects valued at \$500,000 or less), the Contractor will prepare the statement of work (SOW), conduct the procurement activity, and supervise the actual construction activities.

In support of this task, the Contractor shall:

1. Conduct a facilities maintenance program for the GDSCC, including all GDSCC buildings and infrastructure.
2. Apply NASA Reliability-Centered Maintenance (RCM) principles (NPG 8831.2, Facilities Maintenance Management), to meet NASA's Critical Facilities Maintenance Assessment (CFMA) objectives.
3. Ensure that its facilities maintenance program complies with NPD 8831.1 Management of Facilities Maintenance. To help implement its facilities maintenance program, follow the guidelines in NPG 8831.2.
4. Generate facilities maintenance functional performance metrics reports, as described in M021, Performance Metrics, in the CDRL.
5. Generate an annual program operating plan (POP) for facilities maintenance, as described in the M018, Annual Operating Plan (AOP), in the CDRL.
6. Maintain buildings so that delicate electronic and electromechanical equipment operates in a clean environment, and personnel work in areas that comply with federal and state health codes.
7. Protect exposed building areas from environmental damage, repairing or replacing the roof and painting the buildings as necessary.
8. Provide a lock-and-key function, including key assignment, maintenance of lock and key records, and key replacement.
9. Ensure that equipment and heavy equipment that is stored outside is protected from the elements.
10. For critical facilities, apply NASA RCM principles to meet the objectives of NASA's CFMA program.

## **2.5.1 Technical Plant Maintenance**

The Contractor will maintain the technical plant.

### **2.5.1.1 Heating, Ventilation, and Air Conditioning**

Heating, ventilation, and air conditioning (HVAC) equipment and controls include air conditioning (including building and antenna-mounted air conditioning), cooling towers, chillers, heat exchangers, liquefied petroleum gas (LPG) boilers, heat pumps, water heaters, resistance heating strips, and radiant heating panels.

In support of this task, the Contractor shall:

1. Perform preventive, predictive, and corrective maintenance on all HVAC equipment and controls.

### **2.5.1.2 Plumbing**

The Contractor will be responsible for all plumbing maintenance.

In support of this task, the Contractor shall:

1. Perform preventive, predictive, and corrective maintenance on all GDSCC plumbing, including:
  - a. Plumbing fixtures (sinks, toilets, urinals)
  - b. Piping (all water pipes, those pipes feeding the oxidation ponds, and the septic tanks)
  - c. Water storage tanks (potable and nonpotable), valves, and pumps
  - d. Fire suppression and protection systems
  - e. Reverse-osmosis water-purification system
  - f. LPG storage tanks

#### **2.5.1.3 Electrical and Power Distribution System**

The electrical equipment and power distribution systems include:

- The primary, 12-kV power-distribution system, consisting of pole lines, underground cables, circuit breakers, and transformers
- The secondary power-distribution system, consisting of 2400-V and 110-V systems, circuit breakers, and transformers
- Uninterruptable power supply (UPS) systems
- Safety and electronic grounding systems
- Incandescent lighting
- Fluorescent lighting

The primary source of power for the GDSCC is firm power from SCE. The firm power enters the GDSCC at three points:

- A circuit breaker near the main guard gate
- A circuit breaker at the Apollo station
- A circuit breaker at the Mars station

SCE now maintains the pole-mounted power lines and poles.

In support of this task, the Contractor shall:

1. Perform preventive, predictive, and corrective maintenance on the electrical equipment and power distribution systems.
2. Maintain the power distribution system per NFPA 70, *National Electric Code*; NFPA 70B, *Recommended Practice for Electrical Equipment Maintenance*; and NFPA 70E, *Standard for Electrical Safety Requirements for Employee Workplaces*.
3. Maintain UPS systems.
4. Maintain the safety and electronic grounding systems per NEC Article 250.
5. Inspect all incoming equipment for compliance with safety grounding requirements per NEC Article 250.

6. Visually inspect all pole-mounted and underground 12-kV transmission lines, including the treated wooden poles, associated circuit breakers, transformers, and switchgear.
  - a. Any person who climbs a pole shall be certified to do so.
7. Maintain underground 12-kV transmission lines.

#### **2.5.1.4 Power Plant**

GDSCC maintains a 9-MW backup electrical generation capability. This capability is used to ensure a continuous electrical power supply. It is used during periods of peak demand on SCE power and during periods of critical mission support.

In support of this task, the Contractor shall:

1. Perform preventive and corrective maintenance of the motor-generator sets, diesel generators, switchgear, and other peripherals, including batteries, circuit breakers, and switches.
2. Change the oil in the generators, change filters, clean and adjust contacts, and replace battery-distilled water as required by use.
3. Following manufacturer's recommendations for diesel engines (usually after 10,000–15,000 hours of operation), perform top-end overhauls.
4. Following manufacturer's recommendations for diesel engines (usually after 20,000–30,000 hours of operation), completely tear down and rebuild the engines, and replace all marginal components in the fuel system, cooling system, and lubricating oil system.
5. Ensure that the generators will start up automatically and that the power distribution system will switch over to generator power, should commercial power fail.
6. Maintain and regularly test:
  - a. The load-shedding capability of the GDSCC grid-power control system
  - b. Echo-to-Mars plant tie-line functions
  - c. The automatic switching capability between commercial power and local power.
7. Maintain system redundancy in a high state of readiness.

#### **2.5.1.5 Water Supply**

GDSCC has seven water tanks, with a combined capacity of 5.3 million liters, to store water that is pumped in from Fort Irwin. Water is conveyed by 45 miles of underground water lines, with associated pumps and valves.

In support of this task, the Contractor shall:

1. Periodically inspect the water supply system, including the storage tanks, to determine the integrity of the system.
2. Test the water supply, to ensure that it meet standards for potable water, per 22 CCR 64683 and 22 CCR 64684.
3. Perform preventive and corrective maintenance on the water supply system. Test the water supply after any maintenance activity.

#### **2.5.1.6 Airport**

The GDSCC airport is located at Goldstone Dry Lake. The Contractor will be responsible for maintaining the airport's runway and taxiway.

In support of this task, the Contractor shall:

1. Provide preventive maintenance of the shelter, runway, and taxiway, to ensure safe operating conditions on the runway.
  - a. Sweep away all foreign objects and deposits of windblown or water-deposited sand.
  - b. Patch holes, replace sections, and slurry seal the runway and taxiway, as required.
2. Keep the windsocks in good condition, replacing them when they are no longer serviceable.
3. Restripe the runway and taxiway with high-visibility paint, in accordance with NASA requirements, when necessary to ensure safe operations.

#### **2.5.1.7 Buildings**

The Contractor will modify buildings (e.g., remove or install interior walls, doors, or windows) to support the installation of new equipment or capabilities.

In support of this task, the Contractor shall:

1. Modify buildings to support the installation of new equipment or capabilities.

#### **2.5.1.8 Roads and Drainage Systems**

The Roads and Drainage Systems task applies to all main roads except for NASA Road from the GDSCC main entrance to Barstow Road, the access roads leading to all the DSSs, and the apron around each antenna.

In support of this task, the Contractor shall:

1. Maintain all applicable roads, antenna aprons, and parking lots, to ensure that they are in drivable and safe condition.
  - a. As necessary, apply slurry seal coat to all paved surfaces.
  - b. Keep all road surfaces reasonably clear of foreign objects, including sand.

- c. As necessary, patch all holes and replace sections of road.
2. Maintain sufficient drainage along roadside shoulders and drainage ditches to protect the road surfaces from heavy water flow, regrading the drainage as necessary to protect road surfaces from excessive flooding.
3. Repaint the centerline of the roads with high-visibility paint, in a color specified by the California Department of Transportation Specification #8010-20B for Paint, Waterborne Traffic Line, White, Yellow and Black.

#### **2.5.1.9 Septic System and Oxidation Ponds**

In support of the Septic System and Oxidation Ponds task, the Contractor shall:

1. Clear all oxidation ponds of debris and weeds.
2. If a pond has been in use during the year, drain the pond, clean the pond bottom, and dress the slopes.
3. Periodically inspect all septic tanks, and provide for the pumping out of these tanks when the tanks approach full capacity.
4. Maintain the sewage system in such manner that the system will pass, without exceptions, the semiannual inspections conducted under the auspices of the State of California Environmental Protection Agency.

#### **2.5.1.10 Landfill**

The Contractor will be responsible for monitoring the GDSCC Echo Site Class-III landfill. JPL and NASA are aware of potential issues related to groundwater contamination that may be caused by the landfill's contents. The Contractor is not responsible for the resolution of these issues.

In support of this task, the Contractor shall:

1. Ensure that the landfill complies with the California Integrated Waste Management Board Title 27 CCR.
2. Process and analyze data from the landfill's automatic moisture-probe monitoring system.
  - a. Correlate these data with data from an installed automatic weather monitoring station at the site.
  - b. Submit the landfill data quarterly to the Lahontan Regional Water Quality Control Board.
  - c. Maintain copies of landfill data on site at the GDSCC for inspection.
3. Notify the CTM and the JPL Environmental Affairs Office of all Echo Landfill-related inspections.
4. Provide the CTM and the JPL Environmental Affairs Office with copies of all Echo Landfill-related inspection reports, including inspections initiated by any California regulatory agency (state or county).
5. Provide the CTM and the JPL Environmental Affairs Office with copies of groundwater monitoring and vapor monitoring data.

6. At the landfill:
  - a. Maintain the following systems:
    - i. Moisture-probe monitoring system
    - ii. Weather monitoring system
    - iii. Solar panel/battery-powering system
    - iv. Lightning protection system
  - b. Maintain the communications line between the landfill and the PC data collection system at the Echo Site Safety and Environmental Compliance Office.
7. Periodically inspect the landfill cover to determine whether its structural integrity has been compromised.
8. Maintain the landfill cover material and the contour surface drainage design in the configuration agreed to by the JPL Environmental Affairs Office and the State of California.

#### **2.5.1.11 DSN Facilities Master Plan**

In support of the DSN Facilities Master Plan task, the Contractor shall:

1. Maintain the DSMS 890-165, *Directory of DSCC Facilities: the Goldstone Gold Book*, by updating it to reflect the current state of GDSCC facilities and infrastructure.

#### **2.5.2 Heavy Equipment Maintenance**

The Contractor will frequently use heavy equipment to move heavy, bulky objects and lift them at least as high as 150 feet. Heavy equipment is required for road maintenance, drainage ditch construction, and trash disposal, for example. Heavy-equipment maintenance includes the repair of mechanical, hydraulic, and electrical systems; sheet metal; and paint.

In support of this task, the Contractor shall:

1. Maintain heavy equipment in accordance with current Cal/OSHA requirements (Title 8) and obtain all required safety and operational certifications.

This task has a special provision:

1. The Contractor shall train and certify (in its training and certification program) all GDSCC–resident operators and maintainers of heavy equipment.

### **2.6 Advanced Systems Operations and Maintenance**

JPL uses the Venus site and its 34-meter beam waveguide antenna, DSS-13, to conduct experiments leading to the development of new technologies for NASA–JPL. The Venus site plays a critical role in technology development and scientific research for new microwave and system instrumentation



concepts, for DSMS system-level technology demonstration, and for scientific technology development and observation. Contractors operating and maintaining the Venus site will maintain a close association with technical divisions at JPL.

### **2.6.1 GDSCC Technology and Science Support**

The GDSCC Technology and Science Support task plays a critical role in technology development and scientific research in two primary contexts: (a) the operation and maintenance of DSS-13, the Venus site, and (b) the operation and maintenance of non-configuration-controlled scientific instrumentation.

DSS-13 is operated as a dedicated R&D station for new microwave and system instrumentation concepts, for DSMS system-level technology demonstration, and for scientific technology development and observation. In this capacity, the station maintains a close association with technical divisions at JPL. DSS-13 also supports non-flight-project experiments (such as RFI characterization searches) on an as-scheduled basis.

Non-configuration-controlled scientific instrumentation supports DSN Science experiments in radio astronomy (R/A), including VLBI, radar astronomy, and radio science throughout the complex, especially at DSS-13 and DSS-14.

This task also includes maintaining and operating the GAVRT antenna(s), as described in GAVRT MOU 99-720-149. Personnel for all of these science activities often work directly with JPL engineers and scientists.

Both DSS-13- and DSS-14-based work requires:

- Reviewing experimenter's test plans
- Furnishing technical advice
- Determining if existing technical resources and operational procedures are adequate to support planned activities
- Maintaining the non-transferred equipment in a functional state
- Designing, fabricating, and implementing prototype equipment and test fixtures
- Returning the equipment to a standard configuration after any activities that require a combination of DSN-configuration controlled and non-configuration-controlled scientific instrumentation

A high level of technical expertise is required to operate the DSS-13 core equipment and the DSS-14 radio astronomy and radar equipment. Operational support consists of a number of scenarios:

- Collaborating onsite (at GDSCC) and remotely with visiting investigators
- Conducting observations independently from detailed, investigator-provided, sequences of events
- Executing investigator-provided scripts for automated operations
- Developing automation scripts from investigator-provided sequences of events

In support of this task, the Contractor shall:

1. Provide VLBI support:
  - a. Operate the MkIV, MkV, and S2 VLBI data acquisition terminals and the PC Field System (PCFS), a monitoring and control system for these terminals.
  - b. When necessary, use DSS-13 in conjunction with DSN operational antennas for DSN VLBI operations.
2. Provide antenna calibration support:
  - a. Make precision radiometry measurements.
  - b. Use JPL-developed tools to make measurements required for determining antenna gain and efficiency and for developing pointing models.
  - c. Detect substandard antenna performance.
3. Provide spectrometer support:
  - a. Operate wide-bandwidth, high-resolution spectrometers, such as the Wide-Band Spectrum Analyzer (WBSA).
  - b. Help investigators perform spectroscopy.
4. Administer computer systems on Sun OS/Solaris, HP-UX, and Linux platforms.
5. Provide software support:
  - a. Perform limited computer programming, employing Unix shell scripting, Tcl/Tk scripting, Visual Basic, and the C language.
  - b. Develop and maintain Web-based graphical documentation.
6. Provide radio- and microwave-frequency instrument support service:
  - a. Test, diagnose, operate, and maintain the wide range of radio- and microwave-frequency instrumentation fielded at the GDSCC, including GPIB/IEEE 488 bus-based systems, HP modular measurement systems, special-purpose mixers, synthesizers, downconverters, and calibration devices such as noise diodes and ambient loads.
  - b. Provide limited design, engineering, and implementation capability.
7. Provide GSSR service:
  - a. Operate the GSSR controller.
  - b. Load provided predict files into the Programmable Local Oscillators (PLOs), which remove Doppler shifting on receive, and impose Doppler shifting on transmit.
  - c. Perform boresights as needed to improve pointing in real time.
  - d. Create comprehensive log files of experiments.
  - e. Diagnose problems in the GSSR hardware located in the DSS-14 pedestal.
  - f. Follow checklists for setup of various radar configurations.

- g. Monitor the subreflector controller and the antenna pointing assembly, as well as the PLOs and high-power transmitter.
- 8. Provide GAVRT support service:
  - a. Perform engineering support, requiring the services described in items 1–6, for equipment located at the GDSCC that is used by the GAVRT educational outreach project.
- 9. Provide DSS-13 (Venus site) maintenance service. Within the buildings of DSS-13, maintain, without degradation or loss of performance, prototype, experimental, test bed, and developmental equipment and systems, including:
  - a. Media calibration/weather station
  - b. Low-noise receiving systems at S-band, X-band, Ku-band, K-band, Ka-band, Q-band, and W-band
  - c. Simultaneous antenna pointing and tracking systems
  - d. X-band and Ka-band transmitters
  - e. Intermediate-frequency (IF) signal-distribution systems
  - f. Back-end processing systems for radiometry, VLBI, spectroscopy, full-spectrum recording (including delta-differenced one-way range [DDOR]), and radar processing
  - g. Capability for monitoring and control
- 10. Provide special DSS-14 R&D cone and pedestal maintenance service. Maintain, without degradation or loss of performance, prototype, experimental, test bed and developmental equipment and systems, including:
  - a. Low-noise receiving systems at S-band, L-band, X-band, and K-band
  - b. High-power X-band transmitters
  - c. IF signal distribution systems
  - d. Back-end processing systems for radiometry, spectroscopy, and radar operation and processing
  - e. Capability for monitoring and control
- 11. Provide user results and summary reports:
  - a. Generate user results reports, including a performance summary critique, for all activities in response to the specified deliverable requirements. (The user, or station proxy, is responsible for input to the performance critique for each activity.)
  - b. Submit monthly tabulated or summary reports describing GDSCC Science and Technology activities to the IND Research & Development Project Element Manager (R&D PEM) and the DSN Science Service System Manager (SSM).

12. Provide performance metrics:
  - a. Tabulate and monitor customer feedback for each activity.
  - b. For each activity, use a simple automated request (e-mail or Web-based form) to gather user feedback.

This task has a special provision:

1. The Contractor shall provide a CRDE who is qualified as described in Appendix J, Contractor Staff Roles.

## **2.6.2 High-Power Transmitter Test Facility**

The DSS-13 High-Power Transmitter Test Facility (HPTTF) is used for designing, developing, and testing high-power microwave transmitters, subsystems, and components. It supports the unique requirements of the GSSR, and its facility tests the X-band radar components, including the 250-kW CW klystrons. The HPTTF complements and supports the DSN high-power 500-kW CW S-band transmitters and serves as a test bed for design and development support of these assets.

The HPTTF is the central test facility for all of the high-power RF uplink requirements in the DSN. Its support at low power includes the DSS-13 20-kW X-band systems in the pedestal of DSS-13. Operations and maintenance of these transmitters extends to high-voltage systems, cooling systems, advanced high-power microwave components, and power-combining technologies.

In support of this task, the Contractor shall:

1. Participate in development activities.
2. Maintain and perform R&D for the DSS-13 HPTTF and support JPL-directed transmitter activities at DSS-13.
3. Maintain cognizance of the two high-power, 500-kW R&D transmitter systems (S-band and X-band).
4. Review transmitter status, determine the need for upgrade or modifications, and perform installation.
5. Engineer, design, fabricate, install, and test R&D transmitter system equipment or other supporting hardware.
6. Support high-power transmitter operations (i.e., mapping solar system objects) and other tracking duties.
7. Perform R&D engineering-level assembly and fabrication from rough drawings and sketches.
  - a. Modify or create drawings or sketches to reflect work done.
  - b. Release drawings to the JPL Product Data Management System (PDMS) as required.
8. Generate, validate, and apply test procedures to ensure satisfactory operation of assigned equipment.

9. Use the latest welding, brazing, heliarc, and silver soldering techniques.
  - a. Perform various machine shop tasks that involve operating machine tool equipment such as lathes, milling machines, drill presses, saws, shears, and brakes to a high level of accuracy.
10. Provide weekly status reports to the CTM.
11. Provide performance metrics for the following:
  - a. Minimal downtime of the GSSR or DSN high-power transmitter.
  - b. No degradation in the mean time to repair (MTTR) of the GSSR or DSN high-power transmitters.
  - c. On-time delivery of products, design services, or hardware, including documentation. (On-time delivery of hardware is measured against developed schedules as a new task is defined and parameters are set.)
  - d. Customer satisfaction for service performed, as determined by customer surveys.

This task has a special provision:

1. The Contractor shall provide HPTTF Staff qualified as described in Appendix J, Contractor Staff Roles.

## 2.7 Technical Services

Technical Services are functions that support GDSCC operations and maintenance. Technical Services include workmanship assurance, documentation, training, logistics, supply disbursement, and GDSCC procurements.

### 2.7.1 Workmanship Assurance

The Contractor will assure the workmanship of all of repairs and modifications at the GDSCC.

In support of this task, the Contractor shall:

1. Establish and follow a Workmanship Assurance (WA) Program for all the repair and modification activities that it conducts at the GDSCC.
2. Ensure that the WA Program complies with DSMS Document 874-021, *Workmanship Assurance Program for Goldstone DSCC*, and DSMS 813-012, *Quality Assurance Program Plan for the Deep Space Network Hardware*.
3. Correct all discrepancies identified in the report of the annual audit performed by the JPL Quality Assurance organization and the JPL DSN WA Manager.

### 2.7.2 Documentation

The Contractor will provide documentation services and keep necessary records.

In support of this task, the Contractor shall:

1. Provide a documentation production, reproduction, and distribution capability at the GDSCC.
2. Maintain a central repository of records and historical documentation to allow operations and maintenance staff to perform data analysis and forecast planning, to aid in JPL problem investigations, and to provide event traceability.
3. Maintain records of all training, licensing, and permits that are required to meet Contractor, JPL, and government audits.
4. Retain all documents and records for the duration of the contract.

### **2.7.3 Training and Certification**

The Contractor will provide training and certification for its GDSCC employees.

In support of this task, the Contractor shall:

1. Develop and administer a comprehensive training and certification program that includes:
  - a. New-employee orientation.
  - b. Specialized training and certification for RF, digital, mechanical, electromechanical, and hydromechanical maintenance personnel.
  - c. Specialized training and certification for real-time operations personnel, ensuring that they are thoroughly trained in the procedures for tracking operations.

### **2.7.4 Logistics**

The Contractor will implement a logistics system to ensure that the GDSCC receives equipment, spare parts, supplies, data, and documentation in a timely manner.

In support of this task, the Contractor shall:

1. Develop and administer a logistics system that:
  - a. Allows the GDSCC to ship equipment, supplies, data, and documentation to other DSN facilities.
  - b. Includes shipping, receiving, warehousing, supply issuance, and transportation activities.
2. Keep a thorough accounting of all materials processed by this task.
3. Provide warehousing to hold sufficient quantities of materials and equipment to support GDSCC operations:
  - a. Secure warehousing for the GDSCC spares.
  - b. Provide an inventory control system to control all warehousing and supply functions.

### **2.7.5 Supply Disbursement**

The Contractor will disburse materials and supplies.

In support of this task, the Contractor shall:

1. Control disbursement of all material and supplies, maintaining full accountability for all material and supplies issued.
2. Operate a supply disbursement function that provides full accountability by using an issue/receipt voucher process.

### **2.7.6 GDSCC Procurements**

The Contractor is responsible for any procurement, including subcontracts, that it requires to support the GDSCC.

In support this task, the Contractor shall:

1. Establish a procurement capability. The Contractor procurement capability shall guarantee that all materials and supplies are obtained in a cost-effective and timely manner, and that no GDSCC commitment is jeopardized by the late delivery of material and supplies.
  - a. Provide the procurement capability during weekday day-shift hours at GDSCC.
  - b. Provide an emergency-procurement capability outside of weekday day-shift hours for GDSCC.
2. Operate the procurement capability in accordance with JPL, NASA, and Contractor procurement standards.
3. Provide for the purchasing and subcontracting of materials and services, including the equipment required to perform the tasks described in this document.
4. Provide access to procurement records to JPL, the California Institute of Technology, and U.S. Government auditors as required.

## 3 NETWORK OPERATIONS AND SERVICES

---

This section describes both the real-time tasks required to control, monitor, and coordinate Deep Space Network tracking operations, and the non-real time Support Services required to globally conduct network operations.

Real-time network operations tasks include:

- Operate and maintain the Deep Space Operations Control Center (DSOCC)
- Deliver committed data to Deep Space Missions Systems (DSMS) customers
- Plan, document, and train for mission-specific operations
- Schedule network resources
- Monitor network system performance
- Generate, document, and maintain network operations procedures

Non-real-time support services include:

- Generate and maintain mission-independent standard operating procedures
- Generate mission-specific operations plans
- Administer the engineering change management (ECM) process
- Operate and maintain a development and test facility
- Maintain performance measurement software and report on network performance
- Maintain and manage network documentation
- Provide maintenance, sparing support, and logistics
- Provide ionospheric, tropospheric, and Earth-orientation data to flight-project customers
- Perform radio-metric data conditioning.

### 3.1 Network Operations

To ensure that the DSMS provides correct and complete data and information flow through all of the data and control interfaces to flight project customers, the ongoing, worldwide DSMS flight project support operations must be monitored, controlled, and coordinated. Network operations performs this high-level control function. Network operations provides the overall network control, monitor, and analysis of the real-time tracking operations of the DSMS and maintains continuous voice and data contact with each DSN complex. The communications circuits to support these functions are provided by the NASA Information Services Network (NISN). The Contractor will maintain terminal equipment provided by JPL, coordinating restoration of failed circuits with NISN and the circuit vendors, and for participating in integration testing of new circuits and upgrades of communications equipment.

Network operations also provides the operation of a data records system that gathers, assembles, stores, and distributes all necessary operational data records of the DSN. Network operations coordinates and resolves with flight



projects real-time problems/issues with ongoing flight project supports, works with the flight projects to resolve asset contention issues arising in real-time, coordinates Spacecraft Emergency issues in real-time, ensures the opening of discrepancy reports (DRs) as required, and alerts DSMS management to serious problems as they arise within the network.

Network operations performs real-time level-zero data processing on DSN radio-metric, telemetry, command, and monitor data, and distributes these data to the flight projects (front end operations of the Advanced Multi-Mission Operations System [AMMOS])

Network operations functions will remain located at JPL and will be provided 24 hours a day, seven days a week.

Network support services compose all the support functions directly related to the DSMS service execution process. These functions include planning; testing; generating and providing support products used for tracking activities; data acquisition; processing, recording, and distribution of customer data; network performance analysis and anomaly recovery; and documenting discrepancies.

Comprised of the following operational elements, the DSOCC provides operational support to flight projects:

- Network Operations Control Center (NOCC), building 230 1<sup>st</sup> floor
- Network Support Subsystem (NSS), building 230 basement
- Network Very Long Base Interferometry (VLBI) Processor (NVP), building 230 basement
- Data System Processing Area (DSPA), building 230 3<sup>rd</sup> floor
- Wide Band VLBI Correlator (WBC), building 502 1<sup>st</sup> floor (Contractor-leased facility)
- Remote Operations Support Area (ROSA), building 507 1<sup>st</sup> floor (Contractor leased facility)
- Central Communications Terminal (CCT), building 230 basement
- Data Systems Operations (DSO), building 230, 1st floor
  - Telemetry Interface System (TIS), building 230, 3<sup>rd</sup> floor
  - Ground Interface Facility (GIF), building 230, 3<sup>rd</sup> floor
  - Special Function Gateway (SFG), building 230, basement
  - Tracking Data Delivery System (TDDS), building 230, 3<sup>rd</sup> floor
  - Telemetry Delivery System (TDS), building 230, 3<sup>rd</sup> floor
  - Distributed Objects Manager (DOM), building 230, 3<sup>rd</sup> floor
  - Space Link Extension (SLE), building 230, 3<sup>rd</sup> floor
  - Data Monitor Display (DMD), building 230 3<sup>rd</sup> floor
  - Monitor Interface Assembly (MIA), building 230, 3<sup>rd</sup> floor
  - Tracking, Telemetry, Command and Data Management System (TTC&DM), building 230, 3<sup>rd</sup> floor

These operational elements will remain at JPL or within the Pasadena area.

Non-real time functions are currently conducted from a variety of Contractor leased facilities in Pasadena and elsewhere, including:

- WBC, building 502 1<sup>st</sup> floor, Pasadena, CA
- Development and Test Facility (DTF), building 605, Altadena, CA
- Compatibility Test Trailer (CTT), building 605, Altadena, CA
- Merritt Island Launch (MIL), Kennedy Space Center (KSC), FL
- DSN Logistics Facility (DLF), building 504, Pasadena, CA
- Development facility (hardware and software), building 510, Pasadena, CA
- Operations Support Facilities (Scheduling, ECM, Support Products, Software Production Management and Control [SPMC], etc.), building 507 and 510, Pasadena, CA

### **3.1.1 Control Center Real-Time Operations**

#### **3.1.1.1 Real-Time Operations Control and Monitoring**

Real-time coordination and control of DSMS operations is required to provide committed DSMS operational support to all flight project customers. Network operations performs DSMS real-time coordination and control 24 hours a day, seven days a week. This task provides a central point of monitor and control for the worldwide DSMS support facilities and a central point of contact for all of the flight project customers.

Network operations coordinates resource conflict resolution and failure recovery actions within the DSN. The network-operations leader (“Operations Chief”) represents DSMS Management for all ongoing DSMS flight project operational support, and is the ultimate real-time authority for ongoing DSMS operations.

Network operations also maintains the cognizance and recording of the current DSMS status and support capabilities. Voice communications will be established and maintained within the DSMS Support Facilities. Station configuration and performance will be monitored to ensure compliance with published requirements, standards and limits, and the timely execution of planned sequences and procedures. Accurate and complete records of events occurring in the course of tracking operations will be maintained, along with detailed descriptions of anomalies or failures and all perturbations in the delivery of committed data. Network operations will ensure that all data losses are formally documented in DRs. Supporting data, such as predictions, schedules, and SOE will be provided to the tracking stations in a timely manner. Assistance will be provided for failure recovery action, primarily by providing equipment restoral priorities to match flight project requirements and priorities. Current equipment status of the DSN will be maintained through daily DSN status reports.

Because of the heavy user load on the DSN, spacecraft tracking activities are typically conducted continuously. To assure that all the flight project customers of the DSN receive the quality and quantity of data they need, it is necessary to

monitor the configuration of and analyze the performance of the DSN monitor and control, telemetry, tracking, command, radio science, and VLBI systems, and the AMMOS front-end data processing subsystems. This task comprises monitoring the configuration of DSN systems and comparing them to mission-dependent parameters published in the associated network operations plans, and monitoring the received data, and comparing it with expected values. The station configuration will be verified prior to command transmissions. The command system status will be monitored prior to command transmission. All command transmissions will be verified. The telemetry system will be monitored and its performance analyzed using various spacecraft and ground system parameters. Telemetry predictions will be adjusted in real time in response to telemetry system or spacecraft configuration changes.

The AMMOS comprises hardware and software used to receive the captured data from the DSN. The AMMOS performs level-zero data processing, provides archival and distribution services for spacecraft telemetry data, spacecraft tracking data, and ground-system-monitor data for the flight projects.

Network operations for AMMOS consists of:

- Monitoring the AMMOS ground system, including monitoring mission-data system connections, project databases, application servers, firewalls, and intrusion-detection equipment.
- Providing support services, including AMMOS data-system monitoring, data acquisition, level-zero data processing, data recording, problem analysis, anomaly recovery, system testing, and the distribution of customer data.

In support of this task, the Contractor shall:

1. Operate all DSOCC elements, providing real-time operations 24 hours a day, seven days a week.
2. Provide the central point for monitoring, establishing voice and data communications paths (provided by NISN), controlling, and coordinating DSMS resources committed to the support of DSMS scheduled activities.
3. Coordinate with the DSCCs, Project Operations Control Centers (POCCs), and JPL and Contractor personnel to ensure support of DSN scheduled activities.
4. Function as the central "help" facility for flight project customers.
5. Coordinate all problems with the DSCCs and report data outages through the JPL Discrepancy Reporting Management System (DRMS) in accordance with DSN document 841-001, *Standard Operations Plan for the Deep Space Network*, and DSN Document 842-50-311, *DSN Discrepancy Reporting Policy and Operations/Management of the Discrepancy Reporting Management System*.

6. Coordinate Network resource conflict resolution and failure recovery actions as required.
7. Provide real-time reports to DSMS Operations Program Office personnel.
8. Provide accurate and complete records of events and actions for each scheduled event.
9. Each morning, prepare and publish a daily status report (DSR) that summarizes each support provided, DSN equipment status, and provides details on any problems encountered.
10. Make provisions for additional specialists to support flight project critical events.
11. Monitor station configuration and performance to ensure compliance with published requirements, standards, and limits.
12. Ensure that operators maintain and enhance proficiency through participation in training classes and exercises, in addition to on-the-job experience.
13. Document data losses in DRs.
14. Ensure supporting data, such as predictions, schedules, and SOE are provided to the tracking stations in a timely manner.
15. Monitor the configuration of and analyze the performance of the DSN monitor and control, telemetry, tracking, command, radio science, and VLBI systems.
16. Provide assistance to stations for failure recovery action, primarily by prioritizing equipment restoration to match mission requirements.
17. Establish required AMMOS system configurations for flight and test activities.
18. Maintain and operate AMMOS data systems and establish backup configurations.
19. Coordinate the reception, processing, and distribution of spacecraft telemetry, radio-metric, and DSN-monitor data.
20. Maintain space link extension (SLE) password files for flight projects.
21. Provide fault isolation analysis of operational problems.
22. Archive spacecraft data.
23. Maintain, make available, and archive a catalog and library of project data.
24. Operate, maintain, and system-administer all DSMS equipment and software within the DSMS firewall, including the firewall and local area networks (LANs) and excluding flight-project hardware, software, and connections to the firewall.
25. Lead a system administration team consisting of system administrators from the Contractor, DSMS, and flight projects, to ensure the overall coordination of the configuration of workstation AMMOS software.
26. Verify that the project workstations operating within the DSMS firewall meet DSMS IT security and configuration requirements.

27. Perform these functions at the ECC when it is activated.
28. Attend operations working groups and technical interchange meetings at the GDSCC, Pasadena, and the overseas complexes.

#### **3.1.1.2 Option to Relocate NOCC and Data Systems Operations Monitor Functions**

The NOCC and the Data Systems Operations monitor functions of the AMMOS front-end operations reside in Building 230. The DSMS Operations Program Office is considering relocating these functions to the Pasadena area. Should these functions be relocated, the Contractor will perform the relocation.

In supporting this potential task, the Contractor shall provide, as an option:

1. Relocation of the NOCC and Data Systems Operations monitor functions to the Pasadena area:
  - a. A control area that is expandable up to 50% without relocating to another facility and that accommodates 10 positions consisting of:
    - i. Fifty-one monitors and associated workstations
    - ii. Ten Voice-Operational Communications Assembly (VOCA) stations
    - iii. Three stand-alone administrative workstations
    - iv. Two 50-inch plasma-screen monitors.
    - v. Four laser printers, one facsimile machine, and one color copier.
  - b. Console space to accommodate 10 real-time operations personnel. The Contractor shall staff eight of these positions 24 hours a day, seven days a week; two additional positions shall be provide for Contractor and DSMS Management personnel, during critical activities.
  - c. Office space for Contractor non-real-time support staff, Contractor management, and DSMS management.
  - d. Space for Contractor technical advisors. Consider collocating the ROSA.
  - e. A location no further than 12 miles from JPL and preferably within 2 miles.
  - f. Two T1 circuits to provide voice and data communications between the (new) NOCC and building 230.
  - g. Compliance with physical security requirements (NPG 1620.1, *Security Procedures and Guidelines*) and IT security requirements (NPG 2810.1, *Security of Information Technology*).
  - h. A conference room.
  - i. A public and VIP viewing area, separate from the operational area.
  - j. Storage space for work-related material, documentation, office supplies, and personal effects.
  - k. An uninterruptible power supply (UPS) for extended, self-contained operations up to eight hours.

### 3.1.1.3 Central Communications Terminal Operations

The Central Communications Terminal Operations task includes operating the CCT in accordance with the following DSMS 848 document series procedures:

- Managing a configuration-controlled communications system that includes provision for real-time changes in response to requests from the network operations lead.
- Coordinating with commercial carriers.

In support of this task, the Contractor shall:

1. Operate the CCT 24 hours a day, seven days a week.
2. Monitor and control DSMS communications equipment at remote sites, overseas complexes, and the AMMOS Backbone LAN.
3. Establish and maintain voice and data communications to DSMS customers and facilities during scheduled activities.
4. Monitor the status of the end-to-end data delivery across the DSN and AMMOS for communications services.
5. Provide the central control point for coordinating communications services with commercial carriers, NISN, and DSMS customers.
6. Provide monthly reports on communications network performance and usage, and special reports as required.
7. Operate the DSOCC equipment used to record, process, monitor, distribute, and archive DSN data products.
8. Maintain accountability records for all customer data deliverables including real-time and post-pass deliverables and post-pass gap filling.
9. Operate the Ground Communications System (GCS) in the CCT, including the NISN and GCS subsystems.
10. Maintain communications circuits historical records.
11. Participate in NISN-scheduled circuit acceptance testing that involves the CCT.
12. Ensure that intermediate data records (IDRs) are delivered in accordance with flight project requirements.

### 3.1.2 Operations Support Services

The DSOCC Control Center Support Services task provides the network with the support products necessary to execute flight project support and the infrastructure required to enable the support products. It also involves maintaining the hardware, software, processes, and procedures necessary to generate the support products. Support products consist of:

- Sequences of events (SOEs)
- Antenna (angle, radio-metric, and frequency), telemetry, radio science, and VLBI predictions
- Software support files
- Orbit data files

- Delta-differenced one-way range (DDOR), and VLBI data files
- Ionospheric and tropospheric calibration-data files

In support of this task, the Contractor shall:

1. Ensure that the support products for network operations are available as required, and that committed data services are being provided to the flight project customers.
2. Generate, validate, and transmit DSN SOEs based on customer inputs.
3. Generate and validate antenna pointing, radio-metric data (Doppler and range), telemetry, radio science, and VLBI predictions according to the DSN support schedule.
4. Develop and maintain complete and accurate telecommunications database models and station view periods in the required DSOCC subsystems, for all spacecraft supported by the DSMS.
5. Maintain cognizance and configuration control of software support files (SSFs) in accordance with JPL document 841-001, *DSN Standard Operations Plan*. Coordinate the initial generation of new SSFs with Cognizant Development Engineers (CDEs), and thereafter manage changes to file parameters to account for changing conditions of the spacecraft or ground systems.
6. Provide radio-metric data support for flight project customers, including:
  - a. Validation, merging, and sorting data
  - b. Removing blunder points and other erroneous data
  - c. Correcting data, when possible
  - d. Verifying overall tracking-data quality by using prefit residuals based on a nominal trajectory
  - e. Generating orbit data files (ODFs) from radio-metric data, and delivering them to customers within the schedule agreed to in the detailed mission requirements documents (DMRs)
7. Process DDOR, clock synchronization, and frequency offset data using the network VLBI processor subsystem (NVP). Coordinate and deliver the data to the users within the schedule agreed to in the detailed mission requirements documents (DMRs).
8. Maintain cognizance over and operate the VLBI correlator subsystem, including training of support personnel for both the narrowband and wideband correlators.
9. Provide technical support and system administrators for the DSOCC computers/workstations.
10. For DSOCC systems, install software and hardware upgrades, maintain user accounts, update equipment configuration tables, maintain security of computer systems, maintain configuration control, and restore systems after backup sessions or equipment failures. This includes all hardware and

software used to generate support products and the equipment comprising the DSN mail system.

11. Process tropospheric and surface meteorological data from the DSCCs and global ionospheric data into media calibrations for DSN stations. Deliver the data to customers, within the scheduled agreed to in the DMRs. Provide reports with the results of any required analyses to flight project customers.
12. Ensure that the data required for generating support products at the ECC are kept current.
13. Perform these functions at the ECC when it is activated.

### **3.1.3 Control Center Maintenance**

The Contractor will be responsible for maintaining all the equipment in the DSOCC.

#### **3.1.3.1 DSOCC Maintenance**

The equipment at the DSOCC consists of commercially available hardware, minicomputers, microprocessors, and associated peripherals, with JPL-developed application software. The equipment consists of Sun Solaris workstations, servers, terminals, and PCs.

In support of this task, the Contractor shall:

1. Provide corrective and preventive maintenance.
2. Implement engineering change orders (ECOs) designed to upgrade, modify, change, or enhance the operation of DSOCC equipment.
3. Assist in acceptance testing of all equipment modifications at the DSOCC.
4. Provide system administration on a daily and routine basis for DSN systems and subsystems located in the DSOCC.
5. Provide vendor maintenance.
6. Coordinate equipment changes with the JPL DSMS Operations Program Office and CTM or alternate office.
7. Participate in DSN change control board meetings affecting NOCC or NOCC interfaces.

#### **3.1.3.2 Central Communications Terminal Maintenance**

To provide continuous coverage of spacecraft, the DSMS tracking complexes must be connected to the DSMS NOCC by a communications network. The CCT is the DSMS communications facility at JPL. The Contractor will maintain the CCT.

The equipment at the CCT consists of commercially available communication equipment and minicomputers with associated peripherals and software.



CCT communication equipment consists of

- Communication patch panels
- Digital communications switch
- Multiplexers
- Circuit termination devices
- Test equipment
- Central voice switch (CVS)
- Central voice terminal (CVT)
- Routers

CCT server equipment consists of:

- Disc drives
- Interface and switching controllers
- Communications terminal equipment for voice, high-speed, and wideband data transmission
- Reliable network server (RNS)
- Central data recorder (CDR)
- Special-function gateway (SFG)

In support of this task, the Contractor shall:

1. Provide corrective and preventive maintenance of all of the CCT equipment.
2. Implement ECOs designed to upgrade, modify, change, or enhance the operation of the CCT equipment.
3. Assist in acceptance testing of all equipment modifications at the CCT.
4. Provide system administration on a daily and routine basis for the DSN systems and subsystems located in NOCC.
5. Provide vendor maintenance where applicable.
6. Coordinate equipment changes with the JPL DSMS Operations Program Office and CTM or alternate office.
7. Participate in DSN change control board meetings affecting NOCC or NOCC interfaces.

### **3.1.4 Performance Analysis**

#### **3.1.4.1 Performance Analysis**

The Contractor will regularly monitor the performance of DSN systems, subsystems, and assemblies and periodically analyze the performance data, to determine whether DSN performance parameters such as availability and reliability are within requirements. It also allows the Contractor to detect adverse, long-term trends in these parameters, so that solutions such as upgrades or replacement can be planned.

Network operations staff must know the systems, their capabilities, and their performance standards and limits, to ensure that they can effectively monitor

and evaluate the systems' performance in real time. These staff members will generate, maintain, and update standard operating procedures used to conduct performance analysis during real-time operations.

The Contractor will provide second-level failure analysis of DRs by gathering and analyzing all available data pertaining to the problems. This analysis includes maintaining the associated database of failures for the development of long-term statistics. The Contractor will provide short-term failure history and other inputs to help DSMS Engineering determine whether the problem involves a design defect or a degradation of the system. For several systems, the Contractor will generate predictions of system performance so that they may be compared with the actual performance. The Contractor will generate standards and limits that determine the allowable range of system parameters.

Because much of the performance analysis involves the use of software, the Contractor must develop standard operating procedures for the analysis. The Contractor must have the expertise—including in-depth knowledge of the systems and statistical methods—to ensure that DSN system and subsystem performance meets the functional availability requirements imposed by the DSN and the flight projects' design parameters.

In support of this task, the Contractor shall:

1. Support the DSN systems and subsystems in areas such as maintainability, reliability, restorability, and operability.
2. Support the constant technological evolution of the DSN to implement new technology, add new capabilities in support of DSN commitments, and improve system and subsystem performance.
3. Provide mission-independent system and subsystem level training to network operations personnel. This includes understanding performance capabilities and limitations, using performance analysis tools to evaluate system performance parameters during real-time operations, and generating associated standard operations procedures.
4. Provide network operations with regularly updated status on system performance and capability limitations.
5. Provide technical assistance to DSN real-time operations during mission-critical operations such as spacecraft launches, planetary encounters or flybys, and critical spacecraft maneuvers; during preliminary mission planning; and during test and training exercises.
6. Perform thorough analyses of problems reported on DRs, and investigate and coordinate the resolution of all problems affecting DSN performance.
7. Provide link analysis for spacecraft supported by the DSN as requested. Inputs for the analysis are spacecraft design control tables (DCT) provided by the projects; JPL document 810-005, *DSMS Telecommunications Link Design Handbook*; and input from the JPL Telecommunications and

Mission Systems (TMS) managers and the Contractor's mission service element.

8. Retrieve and analyze frequency and timing subsystem (FTS) data from the DSN facilities, and, when required, direct the facilities to adjust their frequency standards to maintain FTS tolerances within system specifications.
  - a. Provide weekly FTS reports to flight project users and DSN Multimission Navigation.
  - b. Provide DSMS Systems Engineering with quarterly reports that compare the performance of the frequency and timing standards at DSN facilities with the National Institute of Standards and Technology (NIST).
9. Monitor trends in the functional requirement parameters of DSN systems and ensure they are within acceptable limits. If trends indicate impending degradation or loss of committed data or services to DSN customers, immediately notify Contractor and DSMS management.
10. Provide DSN system performance reports on a monthly basis, as specified for OPS004, Technical Reports, in the Contract Data Requirements List (CDRL).
11. Generate special system-performance analysis reports, to assist in resolving problems reported by DSN customers, as specified for OPS004 in the CDRL.

#### **3.1.4.2 Performance Metrics Generation**

Service performance metrics must be generated and analyzed regularly to monitor the performance of DSMS services, to ensure that data delivery is meeting commitments, and to detect trends in service quality. These metrics must provide sufficient information to both the Contractor and DSMS Operations Management so that informed decisions can be made concerning where problems exist in the service execution (SVE) process, and possible mitigation actions can be determined. The metrics will also be used to periodically report on the overall state of the DSMS to Interplanetary Network Directorate (IND) management.

In addition, the metrics are used to evaluate the effectiveness of process improvement initiatives and the performance of new or upgraded capabilities. The data required to generate these performance metrics are currently obtained from the DRMS, as described in SOP 842-50-31, *Standard Use of the Discrepancy Reporting System*, and the DSN scheduling history database. The scheduling history database is maintained on the NSS.

The DRMS provides information on failures of DSMS services and includes such information as:

- The customer that was being supported
- The antenna that was used

- The suspected cause of the problem
- The suspected equipment involved in the failure
- The data types lost or degraded during the failure, a general description of the circumstances surrounding the failure
- Additional ancillary information

The scheduling history database provides

- The scheduled support times
- Customer, antenna, service configuration, scheduling work category codes
- Setup and teardown times for all supports that are conducted on the DSN

Either or both of these databases will be used to generate weekly, monthly, and ad hoc performance metrics. Ad hoc metrics are required to analyze performance for a particular customer, to determine if commensurate performance quality is being provided compared to other customers and for special studies. Most of the performance metrics will be generated and archived in graphical form (such as run charts, pie charts, and bar charts).

In support of this task, the Contractor shall:

1. Generate and distribute to DSMS Operations Management, weekly and monthly scheduling metrics on the use of network assets by work category code, as specified for OPS003, Network and Services Utilization Data, in the CDRL.
2. Generate and distribute to DSMS Operations Management, weekly and monthly service performance metrics, as specified for MO21, Performance Metrics, in the CDRL.
3. Maintain archives of performance metrics for historical trend analysis and special studies.
4. Staff the performance analysis task with knowledge of basic DSN architecture and operations, statistical methods, data collection, manipulation, and analysis, and trend identification.
5. Provide interpretation summaries of any favorable or adverse trends in the performance of DSN systems.

### **3.1.5 Network Activities Planning and Scheduling**

#### **3.1.5.1 Resource Analysis Team**

Resource allocation planning (RAP) is the process of negotiating support requirements among multiple project users of DSN to fit the committed service into the available resources. The Contractor will support the Resource Allocation Planning and Scheduling Office's (RAPSO).

The JPL-led Resource Analysis Team (RAT) is responsible for forecasting and planning the use of DSN assets. In addition to understanding the engineering aspects of allocated DSN resources, the team performing the RAT task will need an understanding and appreciation of science aspects of the remote

sensing being supported and different mission phases and activities supporting the remote sensing spacecraft. The RAT will evaluate user requirements contained in DMRs and other documents to determine expected time available for each user and periods of high contention with other users. The RAT will also conduct "what-if" studies to answer scheduling questions.

Monthly joint user-resource-allocation planning (JURAP) meetings will be held to discuss and resolve outstanding issues. The RAT will prepare materials for these meetings, including recommendations to resolve contentions. Additionally, the RAT will prepare preliminary weekly allocations that are reviewed and discussed at periodic negotiation meetings. Include representatives from each DSN user organization, these negotiation meetings will resolve resource contentions for the next 2 to 12 months.

In addition, the RAT will maintain interfaces with JPL's Mission Data Acquisition Planning (MDAP) team and various other NASA and international flight project schedulers, as required.

A semi-annual Resource Allocation Review Board (RARB) meeting will be held, providing an opportunity for users to present new or modified requirements for antenna support that are upcoming in the next two or three years. The RAT will prepare and present recommendations at this meeting, to help resolve asset contention among users, for the next three years.

The Contractor will publish a long-range plan to forecast future conflicts and overall network loading. Planning schedules for major DSN upgrades will depend on this forecasting capability.

For the load forecasting and scheduling software, the Contractor will:

- Report and track anomalies
- Manage change requests
- Report discrepancies
- Develop procedures
- Manage the documentation
- Interface with JPL software developers

The Contractor will provide the resource analysis support to develop, process, maintain, analyze, report, and publish plans, reports, recommendations, studies, and schedules relating to DSN resource allocation, contentions, and antenna loadings.

JPL will support the Contractor by:

1. Providing regular technical direction.
2. Providing access to JPL's proprietary resource-planning software, associated computer equipment, and the services it deems necessary.
3. Reviewing documentation provided by the Contractor.

4. Providing access to the following, as appropriate:
  - a. User requirements
  - b. View-period data
  - c. Facility implementation, capabilities, guidelines, and constraints

In support of resource allocation, the Contractor shall:

1. Determine antenna availability and capability based on inputs from DSN System Engineering and Implementation.
2. Schedule DSN upgrades during quiescent tracking periods to minimize effects on project users, and identify scheduling conflicts between major projects early on.
3. Provide an eight-week block of conflict-free plans and transfer them to the Network Activities Planning and Scheduling personnel for operational scheduling.
4. Perform analyses and special studies to assess the feasibility of planning options.
5. Support periodic meetings to resolve conflicts and to allocate resources in the most efficient manner.
6. Interact with science and scheduling teams to fully understand, process, and follow data-acquisition plans, requirements, and requests, and determine the optimal times for antenna maintenance and calibration.
7. Generate status reports indicating actual progress versus planned.
8. Develop the DSN loading factors and use requirements for planning future allocations.
9. Publish the quarterly DSN forecast report that shows the long-range DSN loading plans in support of flight projects, radio science/advanced systems research, and special project support.
10. Maintain a current file of station downtime periods and latest project launch dates.
11. Publish a semi-annual report that delineates the latest flight project major milestones, station upgrades dates, and test and training dates.
12. Provide narrative interpretation of historical data analyses to aid in long-range planning.
13. Prepare and deliver special reports as required.
14. Support creation of the long-range plan (forecast). The plan shall cover a period of 10 or more years and shall:
  - a. Forecast for allocation of existing and planned network resources.
  - b. Identify user requirements for each week.
  - c. Estimate periods of high contention for the DSN and users and users' lost times.
  - d. Provide information on antenna subnet capacity and loading.

- e. Provide forecasts and data to help develop long-range strategies for:
  - i. Early resolution of resource conflicts
  - ii. Network design, implementation, and upgrades
  - iii. Mission proposals and design
  - iv. Spacecraft design
  - v. Mission-event timing and priorities
- 15. Support the development of the mid- and short-range plans that include:
  - a. User requirements
  - b. RARB decisions
  - c. RAP agreements
  - d. Station view periods
- 16. Update the mid-range database and prepare the mid-range plan.
- 17. Support the RARB, include providing:
  - a. Forecasts of high-contention periods upcoming in the next two or three years
  - b. Recommendations to resolve or minimize contention
  - c. General recommendations for subsequent years
  - d. The RARB Red Book (two weeks before the RARB)
  - e. Action item lists and minutes
- 18. Evaluate mission requirements for their effects on DSN asset loading.
- 19. Perform special studies, including:
  - a. Updating requirements, major events, and resource availability databases
  - b. Acquiring antenna view periods and updating the view-period database
  - c. Performing analyses
  - d. Preparing and publishing results
- 20. Participate in the monthly DSCC implementation-downtime meetings.
- 21. Chair the weekly midrange conflict resolution and negotiation meeting.

#### **3.1.5.2 Network Activities Planning and Scheduling**

Because demand exceeds supply and all commitments are closely negotiated, DSN tracking resources must be scheduled effectively.

Resource allocation, mid-range schedules, and guidelines are necessary for specifying station staffing hours and the percentage of station time to be dedicated to activities such as the specific times for antenna maintenance, radio astronomy, spacecraft tracking, and the various user priorities.

RAPSO mid-range scheduling will provide to the DSN conflict-free, eight-week planning schedules.

### Short-Term Scheduling

The Contractor will maintain and update the eight-week planning schedule. Each issue of the schedule must accurately document all negotiated user requests and adhere to all guidelines and constraints.

### Non-Real-Time Scheduling

In non-real-time scheduling, the Contractor will generate and distribute the seven-day, combined schedule that is conflict-free.

In support of DSN scheduling, the Contractor will also participate in the JPL RAPSO conflict resolution meetings. These meetings will provide the instructions, coordination, and action required for the publication and distribution of all schedules, in accordance with publication deadlines.

### Real-Time Scheduling

When events dictate, network operations will make real-time changes to the seven-day schedule. In non-real-time, the Contractor will update DSN the seven-day schedule to reflect the real-time changes.

### Analysis and Support

The Contractor will use software tools and techniques to effectively schedule DSN assets.

In support of this task, JPL will:

1. Provide technical direction.
2. Provide technical guidelines.
3. Review documentation provided by the Contractor.
4. Provide access to the following, as appropriate:
  - a. Project tracking requirements.
  - b. View-period data.
  - c. Mid-range scheduling data.
  - d. RAPSO meetings and/or negotiation meetings.
5. Provide DSN resource-allocation scheduling guidelines.

### Requirements

In support of this task, the Contractor shall:

1. Schedule DSN resources based upon resource allocation, mid-range schedules, and guidelines set forth and provided by NASA, JPL, and DSN management; present the resulting DSN Schedule in an accurate and timely manner, using computerized scheduling techniques that maximize DSN use and productivity.



2. Review and generate special investigative reports and management information reports, as required by JPL and NASA, concerning availability and use of the DSN tracking resources.
3. Coordinate publication of the monthly priority guideline and the DSN Scheduling Code Dictionary.
4. Participate in RAPSO RARB meetings and DSN project scheduling meetings.
5. Identify conflicts resulting from change requests to the seven-day schedule.
6. Advise projects, as necessary, of conflicts in the seven-day schedule that need to be resolved.
7. Participate in midrange conflict-resolution and negotiation meetings.
8. Generate, validate, and publish (distribute) seven-day operations schedules and 8-week planning schedules in accordance with JPL Document 841-001, *Standard Operations Plan for the Deep Space Network*.
9. Coordinate scheduling with RAPSO of non-DSN facilities during mutual support periods and as agreed to in the DMR documents and interface control documents.
10. Update and maintain scheduling databases.
11. Provide emergency scheduling support, as required.
12. Coordinate with JPL Operations Chief to send updated schedules to DSN complexes.
13. Prepare and maintain contingency plans for launch slips (24-hour and 48-hour slips), as required.
14. Provide various interim schedules that may be necessary to develop the final schedules.
15. Maintain a historical database, consisting of scheduled events and actual use by users, and provide DSN utilization reports as specified for OPS003, Network and Services Utilization Data, in the CDRL.
16. Provide special reports and studies on past or future DSN utilization, when requested by the RAPSO.
17. Provide monthly inputs to the RAPSO on activities for the JPL Program Management Review.

This task has a special requirement:

1. Because of the specialized nature of this work, JPL will provide technical direction through the DSMS Resource Allocation Planning and Support Office.

### **3.1.6 Mission-Specific Planning and Preparation**

The Contractor will support all JPL and non-JPL projects committed to by the DSMS, including:

- Spacecraft in deep space
- Spacecraft in high Earth orbits (HEOs)

- Spacecraft in low Earth orbits (LEOs)
- An emergency support set of spacecraft
- The Radio Astronomy and Special Activities (RASA) Program.

The complexity of DSMS support for the various flight projects requires that the DSMS accomplish both timely and detailed planning of operational support. The planning has a broad scope, since it must accommodate each flight project's unique support requirements, unique spacecraft characteristics, unique POCC interfaces, the requirements of the RASA Program, and the capabilities and interfaces of the DSMS Facilities.

The Contractor will provide documents that have general information on the DSMS facilities, characteristics, capabilities, interfaces with the flight projects, RASA, ground communications, and DSMS support personnel. These mission-specific documents include:

- Test plans
- Training plans
- Operations procedures
- Critical event plans
- Hardware configurations

To develop these documents, the Contractor will interact with flight project planners. Early interaction with the flight projects ensures that:

- Spacecraft and POCC interfaces with the DSMS are correctly established
- Flight-project-unique support requirements can be accommodated by the DSMS and are correctly planned for early in the mission-planning phase

The Contractor will disseminate these documents throughout the DSMS, allowing enough time for them to be reviewed, studied, implemented, and for test and training to be conducted.

The Contractor will adhere to the document management plan, to control documents and changes to documents.

Because of the complexity of operations and the planning and preparation that must be coordinated, the Contractor will use a checklist to ensure that no activity is overlooked.

Once preparations for a mission or mission critical event are complete, the Contractor will assess DSMS readiness and reports the state of readiness to DSMS management, during the Mission Events Readiness Reviews (MERRs).

The Contractor will generate and distribute a network operations plan (NOP) for each flight project. To the extent possible, configurations and procedures will be mission independent. Planning tasks include:

- Participating in project planning activities as a member of DSMS and project-interface planning teams

- Monitoring DSMS development activities, to ensure that technical capabilities are consistent with project support requirements
- Testing project interfaces
- Managing and executing all required DSMS training
- Ensuring that critical-event planning is adequate
- Generating the overall operations-readiness milestone schedule and monitoring progress against milestones, to ensure that DSN Operations is ready to support the project
- Planning the GCS support configurations for the projects

In support of this task, the Contractor shall:

1. For each mission, generate a mission-specific NOP and update according to changes in operations procedures, mission configurations, or special events.
2. For each critical event supported by the DSN, prepare critical event plans, as specified in the CDRL for OPS002, *Network Operations Plan*, based on detailed system knowledge, telecommunications link analysis, and mission-event-profile evaluation.
3. Present the critical event plans in formal DSMS MERRs.
4. Plan operations for all flight projects supported by the DSMS, including all prelaunch preparations and all required in-flight support, for the duration of the DSMS commitment.
5. Support the JPL Telecommunications and Mission System (TMS) managers in the DSMS Plans and Commitments Office.
6. Assess and ensure the operational readiness of the DSMS, for both routine activities and mission-critical events.
7. Coordinate all activities involving major operational elements of the DSMS, including the DSOCC, AMMOS, DTF, GDSCC, CDSCC, MDSCC, ROSA, MIL-71, flight project interfaces, and other non-DSN supporting elements. This coordination includes testing and training, participating in mission operations planning meetings, and reporting readiness to support.
8. Monitor all DSMS development to ensure that design, schedules, and technical capabilities are consistent with DSN operations requirements and flight-project support requirements.
9. Develop and provide the DSMS Operations Program Office and TMS Managers with DSMS operations milestone schedules for all aspects of prelaunch mission preparation, launch, routine in-flight support, and in-flight mission-critical event planning and support.
10. Plan, conduct, evaluate, and report on all activities required to ensure mission support readiness, in accordance with JPL Document 841-001, *DSN Standard Operations Plan*.

11. Present operational plans and readiness status in formal DSMS MERRs, as specified in the CDRL for OPS001, *Mission Event Readiness Review Materials*.
12. Evaluate mission-specific operational performance of the DSMS, using quantitative metrics whenever possible, and provide periodic oral and written reports to DSMS Operations Program Office Management and TMS Managers.
13. Provide for GCS planning to coordinate and establish data- and voice-communication circuits, interface protocols, and communications terminations as appropriate, to support each mission's prelaunch testing, launch, and in-flight activities.
14. Establish modified configuration control (MCC) during critical mission activities to ensure that no changes are made to the network that would impair its ability to support.
15. Attend operations working groups and technical interchange meetings at the GDSCC, Pasadena, the overseas complexes, and international space agencies.

### 3.1.7 Mission-Independent Products and Procedures (SOPs)

The network operations, Pasadena support personnel, and DSCC operations personnel use system-level procedures to prepare for or directly support tracking operations. These mission-independent procedures are contained in the 84X series of DSMS standard operating procedures (SOPs).

In support of this task, the Contractor shall:

1. Generate and verify SOPs for the network operations, support personnel, and DSCC link controllers.
2. Revise SOPs as appropriate for engineering changes, upgrades, or the addition of new capabilities.
3. Disseminate SOPs.

## 3.2 Network Support Services

The network support services task provides infrastructure for the operation, maintenance, and development of the network. This infrastructure includes:

- Providing a test facility for spacecraft interface and DSN product testing
- Providing configuration management and accountability for all changes made to the network
- Providing online tools for gathering and reporting on network performance
- Producing and distributing network documentation and repairing/replenishing network spares
- Shipping products to and from network facilities

These services are performed in support of all elements of the network, including the overseas DSCCs.

### 3.2.1 Development and Test Services

The DSN development and test services comprise:

- Verifying the compatibility of spacecraft telecommunications components with the DSN, throughout spacecraft development. This verification will usually be performed at the DTF-21 facility. The MIL-71 facility will provide final prelaunch compatibility verification.
- Verifying data flow interfaces for flight projects.
- Verifying end-to-end system compatibility between the DSN and flight projects. These tests may involve spacecraft at the JPL Spacecraft Assembly Facility (SAF) or at remote contractor or government sites. In some cases, the CTT-22 compatibility test trailer will provide remote site support.
- Providing a system-level test environment for product development and acceptance testing.

The three facilities associated with providing these services include:

- DTF-21 facility
- CTT-22 compatibility test trailer
- MIL-71 launch-support facility

The DTF-21 facility duplicates major portions of a DSCC and DSS, less the antenna, servocontrols, radio frequency (RF) amplifiers, and the front-end microwave components. This permits DTF-21 to be used as an engineering test bed for developing DSN subsystems. Its configuration will be controlled by the same ECM system that is used for the DSCCs. Equipment in the development phase will be brought into DTF-21 for integration testing with other subsystems. Although this equipment will not be under configuration control, the Contractor must provide mechanisms to ensure that any special test configurations are documented and that the baseline configuration can be readily restored.

The DTF-21 facility is at 505 W. Woodbury Road, Altadena, California. It comprises about 10,907 square feet for equipment, office space, and RF-compatibility testing. High-rate, fiber-optic, T1 communications links provide the primary connection for interchange of data from DTF-21 to JPL Building 171 and other project facilities. The communications links are leased from the City of Pasadena.

MIL-71 provides a prelaunch compatibility test configuration at the KSC in the period before the launch of the spacecraft. MIL-71 equipment is located in a single room within the Goddard Space Flight Center (GSFC)–Merritt Island Launch Area (MILA) host facility on Merritt Island. MIL-71 will be activated as required for launch support and it will be operated and maintained by the Contractor.

Whenever the facility is activated, Contractor personnel will verify that MIL-71 equipment is properly configured and operational. The Contractor will conduct end-to-end data flow tests. After launch, MIL-71 will be deactivated as scheduled.

CTT-22 is a transportable trailer that contains the telemetry, tracking, command, ground communications, and monitor/control subsystems that normally support 26-meter, 34-meter, or 70-meter tracking activities. The trailer's home base is at DTF-21; it will be moved to remote sites as scheduled.

The Contractor will operate DTF-21, CTT, and MIL-71 to support compatibility testing, development activities, and flight-project special activities. Once a compatibility test has been scheduled, the Contractor will operate all DTF-21 or CTT equipment involved in that particular test configuration and follow detailed test procedures. The Contractor will gather and record test data.

Development support will involve station personnel and development engineers. When integrating new equipment into the DTF-21 configuration, the Contractor must verify that this new equipment is compatible and will not damage existing DTF 21 equipment. Development engineers may operate this equipment for development purposes, but only under a set of guidelines provided by the Contractor.

The Contractor will operate the DTF-21 equipment in specified test configurations, to support flight-project special activities, such as data flow tests of ground data systems. In these tests, the DTF-21 usually will be emulating a DSN tracking station and will process/deliver spacecraft telemetry data for project analysis.

DTF-21, CTT-22, and MIL-71 support the testing of the compatibility of the RF and data systems between a flight project spacecraft and the DSN. The majority of the testing will be performed at DTF-21. Typically, different types of testing will be performed at different facilities:

- DTF 21: RF compatibility and end-to-end testing
- CTT-22: RF compatibility and end-to-end testing, at a project facility remote from JPL
- MIL-71: Final verification of RF compatibility and data flows before launch

The flight project will develop the compatibility test plan but may request Contractor assistance. The plan will define all tests to be conducted, parameters to be measured, and limits for those parameters. Since compatibility testing is conducted in phases, this test plan will also specify the configuration to be employed during each test phase. The spacecraft can be tested in its breadboard, preproduction, proof test model, or flight configurations.

The Contractor will prepare and control the compatibility test procedures. The test procedures must satisfy all requirements contained in the compatibility test plans, per DSMS 814-005, *DSN Flight Interface Compatibility Design Handbook*.

Compatibility testing typically requires several days to several weeks, depending on the spacecraft's complexity and development phase. Because access to the spacecraft will be limited, extended work hours may be required to complete compatibility test sessions. The Contractor may also have to assemble/generate special hardware/software configurations to conduct compatibility tests. The Contractor will produce a detailed compatibility test report, which must be issued in a timely fashion, after testing is complete.

In support of this task, the Contractor shall:

1. Operate and maintain the DTF-21, CTT-22, and MIL-71 subsystems used for compatibility testing, hardware and software development, and flight-project systems testing.
2. Maintain the lease with the City of Pasadena for the communication links.
3. Maintain the lease on the Building 605 location.
4. Transport the CTT-22 to support scheduled tests. Transportation includes securing the required licenses, required permits, and transportation services.
5. Establish and maintain a process for scheduling the DTF facilities to maximize the utilization of the facilities, in support of compatibility tests and development users. The Contractor shall also publish a weekly schedule for users of the facilities.
6. Perform tests that verify the compatibility of the flight hardware with the DSN, in accordance with DSMS 814-005, *DSN Flight Interface Compatibility Design Handbook*. The Contractor shall publish a final compatibility test report, as specified in the CDRL for OPS005, *Compatibility Test Reports*.
7. Interface with TMS managers and flight project representatives to prepare compatibility test schedules, test plan documents, and detailed test procedures.
8. Plan and prepare appropriate test facilities to implement special hardware and software configurations required to support compatibility test activities.
9. Support required testing at JPL, remote spacecraft assembly facilities, or at spacecraft launch sites.
10. Conduct initial compatibility testing (RF tests) and verify compatibility at the launch site. Support end-to-end data flow tests for projects and publish a quick-look report immediately following each test sequence.

11. Control the configuration of transferred hardware and software. The Contractor shall provide procedures and controls for management of development hardware and software that co-resides in the DTF.
12. Assist engineering in implementation and corrective maintenance of non-transferred equipment.
13. Support the reproduction, analysis, and resolution of system-level DSN performance problems.

### 3.2.2 Change Management Tools and Administration

The DSMS operates in an environment of change. Changes are driven by the need to provide new mission-support capabilities and by internal needs to improve operability, maintainability, and safety.

The change management tools and administration task addresses an ECM process that conforms to DSMS configuration management standards and provides tools and procedures to implement those standards in the DSN. The current practice involves monthly meetings of a DSN change control board (CCB), at which proposed changes are reviewed, assessed, and approved. If a proposed change is approved, an engineering change order (ECO) and modification kit (modkit) must be prepared to make the actual product modifications in the field. Change management includes all activities associated with receiving, distributing, and tracking the modkits to their destination subsystems.

Change management also involves managing the executable software products used within the network. Starting with formal acceptance testing, software change management is provided by the software production, management, and control activity. This task will also provide electronic distribution of official software to DSN operational sites and the maintenance of a central library containing all programs and files necessary for software delivery and/or restoration.

In support of this task, the Contractor shall:

1. Administer the online 820-061 database, including weekly updates and change reports (JPL will provide the repository for the database).
2. Schedule and support the DSN CCB meetings, including preparing and publishing agendas and minutes.
3. Provide support services for the change request assessment and approval process, as defined in DSMS 813-023, *DSMS Configuration Management Procedures*.
4. Administer and provide tools for the DSN transfer agreement process, including electronic form access, lien database, maintenance support agreements, and system safety records. The process is defined in DSMS 813-125, *DSN Hardware Transfer & Delivery Procedures* and DSMS 813-126, *DSN Software Transfer & Delivery Procedures*.



5. Monitor and report the status of all ECO modkits, through completion of implementation, including the installation of modkits in each specific instance of DSN equipment.
6. Assign program identifiers to all custom and third-party software (TPS) used within the DSN.
7. Provide a program library of executable software and associated files for all custom and TPS software used within the DSN.
8. Provide a redundant program library outside of the Los Angeles basin, for use in disaster recovery.
9. Provide copies of official software products to the network, for acceptance testing and operation, and ensure the ability to restore a previously delivered software configuration.
10. Operate the DSN online software library that has components at the central site and at each DSCC and that can electronically deliver software products to each site.
11. Provide all status and accountability data/metrics via Web-based reports accessible to all DSMS personnel.
12. Support and plan for improvements to the ECM process and provide associated updates/modernization of supporting tools.

### **3.2.3 Network Documentation**

The network documentation task will provide official DSMS documentation to DSMS users. The official electronic repository for DSMS documents will be at JPL. The Contractor will control documents and changes to documents. The Contractor will enter documents into that repository, remove obsolete documents, and ensure the quality of any ancillary data that is entered into the official document files. After official release by the Contractor, the Contractor will make the documents electronically available to appropriate users. Other document support functions will include:

- Providing standard templates to document owners and preparers
- Providing formatting support for specific DSN document series
- Providing tools and techniques for facilitating document review and approval procedures.

In support of this task, the Contractor shall:

1. Release all DSMS 800-series documents in accordance with DSMS 813-021, *DSMS Document Process Procedures*, except for DSN documents DSMS 820-013, *DSMS External Interface Specifications*; DSMS 820-016, *DSMS Subsystem Software Interfaces*; DSMS 820-017, *DSMS Detailed Hardware Interfaces*; and DSMS 820-019, *DSMS Interface Design Standards*.
  - a. Verify that documents are managed according to DSMS 810-001, *DSMS Documentation Structure, Standards, and Definitions*, to control documents and changes to documents.

- b. Verify that all format requirements of DSMS 810-001 have been met.
  - c. Provide release notifications to personnel on document distribution lists.
  - d. Provide hardcopy distribution only if specifically indicated.
2. Assign numbers to all 800-series documents.
3. Provide document templates for general DSMS documents and for those documents that have internal content standards.
4. Support the approval/review process.
5. Plan for and implement an online review/approval capability for all DSMS documents.
6. Remove obsolete documents from the official repository, and notify appropriate users in the DSMS community. The Contractor shall support activities to identify legacy documents that should be obsolesced.
7. Maintain a central hardcopy library of all official DSMS documents.
8. Administer and operate the DSMS Product Distribution System (DPDS), which provides for the electronic distribution of released DSMS user documents to the user sites. (DPDS will be provided and sustained by JPL.).
9. Provide minor formatting of DSN software operation manuals and release description documents.
10. Help document DSN network operations plans and SOPs.
11. Produce metrics that are key indicators of documentation activities.
12. Provide all status and accountability data/metrics via Web-based reports accessible to all DSMS personnel.
13. Support and plan for improvements to the DSMS documentation process and provide associated updates/modernization of supporting tools.

#### **3.2.4 Network Maintenance Support**

To ensure that the DSN will meet its project support commitments, all equipment must perform within specification. As a diverse and continual activity, DSN maintenance must be both technically appropriate and cost effective. To accomplish this requirement, the Contractor will establish an equipment maintenance program to determine the technical skills, test equipment, test fixtures, and vendor repair services required to maintain DSN equipment.

In support of this task, the Contractor shall:

1. Develop the DSN Equipment Maintenance Program. This program shall identify test and maintenance equipment standards, specialized maintenance fixtures, the skill sets for maintenance personnel, and the scope of vendor maintenance support.

2. Conduct an annual review to verify the integrity and cost effectiveness of the DSN maintenance support capabilities, and recommended changes in an annual report on the Equipment Maintenance Program.
3. Evaluate new equipment and major modifications planned for implementation in the DSN to determine whether the resources and skills exist within the DSN to maintain, repair, test, and calibrate DSN equipment.
4. Every fiscal year, review, assess, and report to the program office the network maintenance capabilities, including the maintenance equipment status and documentation, maintenance training, commercial test equipment, and inventories of operational spares.
5. Support the DSMS Operations Program Office in test equipment procurement and support, spares procurement and support, maintenance training, and the generation of maintenance procedures, in accordance with DSMS 814-007, *DSN Maintenance Program*.
6. Evaluate the relative merits and costs of performing maintenance at the DSCCs, at a centralized Complex Maintenance Facility (CMF) level or by vendor contract, and based on this evaluation, recommend future maintenance locations. Identify any proprietary equipment considerations that mandate the use of vendor maintenance.
7. Secure Vendor repair of applicable DSN equipment items at all DSCC and Pasadena.
8. Within one working day, acknowledge requests from DSN facilities for equipment spares, test equipment, and other supplies needed to sustain operations and maintenance activities.
9. Provide for the storage of the equipment and materials required to support the various DSN facilities, and for the inventory control of these items.

### 3.2.5 Logistical Services

The DLF is the focal point for moving and controlling the materials and equipment required to operate and maintain the three DSN complexes and other DSN facilities. The Contractor will use JPL Shipping & Receiving to ship to the overseas complexes. The Contractor will use the JPL export license to export of International Traffic in Arms Regulations (ITAR)-controlled materials. The DLF will continue to be located in a Contractor-leased facility. Contractor responsibilities will include:

- Shipping and receiving materials, some classified as hazardous materials (HAZMAT)
- Warehousing materials and spare equipment
- Transporting materials and equipment to and from vendors, the DSCCs, and JPL
- Packaging shipments—ranging from pounds to tons—to the three DSN tracking complexes
- Staging equipment modification kits

- Providing cataloging, serialization control, equipment identification, and research services for all items introduced into the DSN.

In support of this task, the Contractor shall:

1. Provide and operate the DLF.
  - a. The DLF shall be located within a 12-mile radius of JPL.
  - b. The DLF shall provide sufficient area to store all DSN network spares.
  - c. The DLF shall be the staging area for ECO modkits and MESkits.
2. Package and ship materials, including documents, spare parts, piece parts, large mechanical devices, DSN racks containing sensitive electronic equipment, magnetic tapes, and software media. Some of these materials are classified as HAZMAT.
  - a. To overseas DSCCs and other sites, as specified by the DSMS program office, through JPL Shipping.
  - b. Directly to GDSCC, CTT-22, DTF-21, and MIL-71.
3. Receive materials shipped from other DSN facilities and distribute these materials to appropriate addressees.
4. Consolidate weekly shipments to various DSN facilities, when possible, and provide for priority shipments to these same facilities.
5. Establish proper procedures and forms necessary to document shipments of material and equipment between Contractor-managed facilities.
6. Use JPL shipping memoranda to record all shipments between Contractor's Southern California facilities and JPL.
7. Send a copy of each shipping document to JPL Property and to JPL Shipping.
8. Establish and maintain a historical file of all shipping and receiving documents.
9. Provide adequate warehousing for material and equipment to support the operations of Contractor-operated facilities (CTT-22, DTF-21, MIL-71, and the NOCC) and DSCCs.
10. Properly store network spares at the DLF except for structural and mechanical spares that are too large to be stored other than in an outdoor secured storage area. The Contractor shall securely store these excepted items at GDSCC.
11. Provide an automated inventory control system to track and account for all items entering, being processed, and leaving the DLF.
12. Perform an annual property audit of items held at the DLF.
13. Operate regularly scheduled delivery service at the Contractor's discretion to meet network delivery requirements between the DLF and JPL, and between the DLF, GDSCC, and Contractor-operated facilities.
14. Develop techniques, processes, and procedures necessary to package DSN material and equipment to meet all expected environments, considering

special requirements for air and sea freight, foreign country packaging requirements (Australia and Spain), and outside storage.

15. Implement a system for staging the completed modification kits at the DLF. When inventory of each modification kit (quantity of materials and documentation) has been certified by JPL Quality Assurance representatives, the Contractor shall send it to the packaging group for eventual shipment to designated destinations.
16. Establish and develop a database that shows the status of each modkit shipped.
17. Provide cataloging, serialization control, equipment identification, and research services for all items introduced into the DSN

The task has the following special provision:

1. Packaging personnel shall be certified, as required, especially for the handling and packaging of hazardous materials.

## 4 NETWORK ENGINEERING

---

The Contractor will support the constant technological evolution of the Deep Space Network (DSN), by implementing new information technologies, adding new capabilities in support of DSN commitments, and improving Deep Space Mission System (DSMS) system and subsystem performance. In the Network Engineering task, the Contractor will:

- Provides the support required for transferring new capabilities from DSMS Engineering (provided by JPL) to all Deep Space Communication Complexes (DSCCs)
- Performs the analysis required to troubleshoot problems and to help DSMS Engineering determine implementation thrusts
- Provides technical expertise in all areas of DSN systems

### 4.1 DSN Engineering

In support of the DSN Engineering task, the Contractor shall:

1. Provide technical support to DSN facilities at both system and subsystem levels, in accordance with DSMS 820-061, *DSMS Subsystem, Configuration Item, and Responsibility Definitions*. The areas of Contractor responsibilities shall include:
  - a. Antenna and mechanical structures
  - b. Antenna drive systems, bearings, and gearboxes
  - c. Antenna pointing subsystem
  - d. Power generation and distribution equipment
  - e. Building structures, roofing systems, lighting, and heating and cooling systems
  - f. Fire protection and fire detection systems
  - g. Roads, water, and sanitary systems
  - h. Fuel storage and distribution systems
  - i. Data processing subsystems
  - j. Radio frequency (RF) receiving and transmitting subsystems
  - k. Ground communications subsystems
  - l. Subsystem interface equipment and cabling
  - m. Frequency and timing subsystem
2. Maintain technical cognizance of end-to-end system configurations, performance parameters, and capabilities.
3. Liaise between personnel at the DSCCs and DSMS Engineering for the resolution of operational problems, failures, and discrepancies.
4. Participate in the development and review of operations concepts and requirements.

5. Participate in all implementation task reviews, as specified in JPL document DSMS 813-101, *Guideline for SCD Reviews*:
  - a. Preliminary Definition and Cost Review (PDCR)
  - b. Preliminary Design Review (PDR)
  - c. Detailed technical reviews (DTRs)
  - d. Peer reviews
  - e. Critical Design Review (CDR)
6. Participate in implementation tasks—from task inception through the operational phase—as requested by DSMS Engineering.
7. Develop and maintain a uniform and consistent spares philosophy, for new implementation and upgrades to the system.
8. Negotiate spares inventory with each implementation task according to the spares philosophy for the implementation of equipment into the DSN.
9. Negotiate for special test equipment required by operations to properly service, measure, and maintain the systems and subsystems.
10. Develop and disseminate information or procedures to the DSN facilities to prevent, avoid, or work around operations and maintenance problems affecting the quantity and quality of data services to the users of the DSN.
11. Review hardware and software anomaly reports (ARs) with Cognizant Development Engineers (CDEs) and coordinate with DSN personnel the preparation of engineering change requests (ECRs) for submission to the DSN Engineering Change Management (ECM) system.
12. Report to and update the CM database by updating the installation, test, and operational status of ECO implementations.
13. Develop, document, and provide DSMS operation test plans (OTPs) for DSN data systems.
14. Participate in the development of all subsystem acceptance testing (AT) documents and operations and maintenance manuals (OMMs).
15. Review and comment on user documents per DSMS 810-001, *DSMS Documentation Structure, Standards, and Definitions*, before their release.
16. Support Test Engineering and Mission Services Engineering in the development, review, and conduct of hardware and software acceptance tests, system performance tests (SPTs), project interface tests (PITs), and demonstration tests.
17. Identify, analyze, and document functional and performance anomalies during the implementation and operational phases and prioritize them for resolution by DSMS Engineering.
18. Facilitate the acceptance and transfer of DSN modification kits for implementation into the DSN.
19. Ensure that all DSN data systems conform to and meet NASA–JPL Information Technology Security guidelines and procedures, as cited in Section 1.1.7.

20. Develop and document operational processes and procedures.
21. Participate in the DSN sustaining engineering process.
22. Recommend design improvements, redesign, upgrades, enhancements, and streamlining of DSN operational data systems.
23. Provide real-time engineering technical support for critical and high-profile DSN activity events as defined DSMS 841-001, *DSN Standard Operating Procedure*.
24. Coordinate with the DSMS Operations Program Office the acceptance of a capability.
25. Travel to the complexes and vendor sites, for implementation, training, and test support.
26. Review all maintenance records, predictive/preventive reports, and inspection reports submitted by the stations and compile a monthly report on the findings listing any concerns. Include this report in a monthly maintenance report package, as described in the CDRL in OPS 004, Technical Reports.
  - a. Deliver this report to the DSN Antenna Maintenance Specialist and the DSMS Facilities and Logistics Office Manager.
27. Monitor the status of spares at each DSCC and their availability, and generate a quarterly report: the Spare Status Report, as described in OPS 004 in the CDRL.
  - a. Deliver this report to the DSN Antenna Maintenance Specialist and the DSMS Facilities and Logistics Office Manager.
28. Identify systemic operational problems by monitoring and analyzing discrepancy reports, and report the findings to DSMS Engineering.

#### 4.1.1 Facilities Implementation Planning

Facilities Implementation Planning provides control of the DSN facilities floor and wall space, an interface between the DSMS Engineering tasks and the DSN facilities, and support of the task through procurement or racks and system cables.

This work area is part of the Service Capability Development process (in Appendix G, Service Capabilities Development Process).

In support of this task, the Contractor shall:

1. Coordinate with the DSMS Engineering task personnel, to document subsystem interface equipment and cabling.
2. Prepare and publish facility implementation plans (FIPs), as required by the engineering task manager, for hardware implementation tasks.
3. Work with the DSN facilities personnel to determine the implementation resource requirements.
4. Prepare and release facility floor-plan drawings using JPL-compatible CAD tools, as defined in DSMS 813-203, *DSN Drawing Format and*



*Content Standards: Vol. 1, Equipment*, of equipment layouts for all DSN facilities and antennas.

5. Release documents and drawings in DSMS and JPL document control systems, as defined in DSMS 813-021, *TMOD DSMS Document Process Procedures*, and 813-022, *DSMS Drawing Process and Procedures*.
6. Provide engineering services to design, define, catalog, and produce system cables and interconnections for intersubsystem and interassembly cables.
7. Provide fabrication services to refurbish or manufacture and maintain an inventory of standard DSN racks, and associated accessories, as defined in DSMS 813-202, *Design Requirements for Deep Space Network Equipment*.
8. Provide general DSN Engineering support, as described in Section 4.1, DSN Engineering, as appropriate.

#### **4.1.2 Antenna-Mechanical Network Engineering**

The Contractor will provide technical support for the antenna structural, mechanical, and Cassegrain assemblies, and for special tooling and instrumentation. This technical support involves the analysis, design, and implementation of new procedures and processes to resolve antenna problems and to improve antenna operational reliability. The Contractor will be responsible for all activities required to ensure the continued operation of the antennas, including development of recovery plans, rigging techniques, and special tooling to minimize antenna outages. The Contractor will develop new procedures or upgrade present ones to support operational and maintenance activities for the structural, mechanical, and Cassegrain assemblies, and for the special tooling and instrumentation. The Contractor will review annually all records for DSN antennas:

- Maintenance records
- Hydrostatic bearing shimming and profile records
- Radial bearing alignment records
- Elevation and azimuth drive alignment records
- Structural inspection reports
- Oil analysis, vibration analysis, acoustic analysis, and infrared analysis reports
- Antenna spares records
- Maintenance records for antenna support equipment

##### **4.1.2.1 Structural Engineering**

In support of the Structural Engineering task, the Contractor shall:

1. Conform to the rules and regulations of the national standards for structural assemblies, materials, and welding codes.
2. Evaluate the condition of the structural assemblies on the antenna and develop all rework/repair operations for its components.
3. Monitor maintenance activities and the installation of all additions to the structural assembly.

4. Review the analysis data and design drawings developed by the design-Engineering group for any proposed modifications to the structural assembly.
5. Develop the lift plans for the removal or installation of new members.
6. Provide general DSN Engineering support as described in Section 4.1, DSN Engineering, as it applies to antenna-structural systems engineering

#### **4.1.2.2 Mechanical Engineering**

In support of the Mechanical Engineering task, the Contractor shall:

1. Conform to the rules and regulations of the national standards for mechanical assemblies and their design.
2. Evaluate the condition of the mechanical assemblies on the antenna, including the alignments of the gear reducers, condition of the hydraulic and electric drives, condition of all rotating assemblies, and the operational status of the hydrostatic bearing assembly.
3. Develop all installation, rework, and alignment procedures for the maintenance activities on all mechanical assemblies.
4. Review the analysis data and design drawings developed by the design engineering group for any proposed modifications to the mechanical assembly.
5. Monitor the condition of the hardware by analyzing the predictive and preventive maintenance reports generated by the maintenance personnel at the stations.
6. Be responsible for keeping track of the availability of replacement hardware.
7. Provide general DSN Engineering support as described in Section 4.1, DSN Engineering, as it applies to antenna-mechanical systems engineering.

#### **4.1.2.3 Cassegrain Assembly**

In support of the Cassegrain Assembly task, the Contractor shall:

1. Conform to the rules and regulations of the national standards for Cassegrain assemblies and their design, materials, and coatings.
2. Develop new procedures used for maintenance activities for the handling and alignments of the reflective structure, subreflector assembly, and mirrors.
3. Analyze antenna performance reports and determine the condition of the Cassegrain assembly.
4. Review the analysis data and design drawings developed by the design-Engineering group for any proposed modifications to the Cassegrain assembly.

5. Monitor the condition of the hardware by analyzing the predictive and preventive maintenance reports generated by the maintenance personnel at the stations.
6. Provide general DSN Engineering support as described in Section 4.1, DSN Engineering, as it applies to the Cassegrain assembly.

#### **4.1.2.4 Special Tooling and Instrumentation**

In support of the Special Tooling and Instrumentation task, the Contractor shall:

1. Design any mechanical equipment needed for the repair, replacement, and alignment of antenna hardware.
2. Monitor the condition of the hydrostatic bearing instrumentation (HBI).
3. Develop any instrumentation that could be used for maintenance activities and monitoring of antenna components.
4. Review the maintenance report for the shimming activities on the 70-m antenna hydrostatic bearing. Generate a report on the condition of the runner and include it in the monthly maintenance report package described in OPS 004 in the CDRL.
  - a. Deliver this report to the DSN Antenna Maintenance Specialist.
5. Provide general DSN Engineering support as described in Section 4.1, DSN Engineering, as appropriate

#### **4.1.3 Microwave Network Engineering**

Microwave Network Engineering supports the Transmitter (TXR) and Microwave (UWV) subsystems. The TXR amplifies the modulated signals to be radiated. The UWV polarizes uplink and downlink signals, amplifies downlink RF energy to telemetry receivers, and transmits uplink signals to the antenna. The Microwave Network Engineering task includes the support, sustenance, and maintenance of the UWV and TXR subsystems, as delivered by DSMS Engineering.

In support of this task, the Contractor shall:

1. Monitor, measure, and analyze the functions and performance.
2. Identify, troubleshoot, and resolve discrepancies, failures, and problems.
3. Measure each antenna's configuration and RF performance at least every six months, or as maintenance, implementations, or failures dictate.
4. Submit a performance report monthly, as described in the CDRL for OPS 004.
5. Participate in the DSMS Engineering System Design Team, to represent operations, implementation, and maintenance interests.
6. Recommend improvements.
7. Survey, inspect, and verify operational equipment and R&D or host-country equipment interfaces at each complex annually, or as required to

ensure the common configuration and uniform designs between subnets and complexes.

8. Provide general DSN Engineering support as described in Section 4.1, DSN Engineering, as appropriate.

#### **4.1.4 Data-Processing-Subsystems Network Engineering**

The Data-Processing-Subsystems Network Engineering task includes engineering technical support for the data systems at all DSN sites:

- Telemetry
- Command
- Monitor and control
- Tracking
- VLBI
- Radio science
- Radio astronomy
- Test support

This technical support consists of operational performance and process analysis and ensuring that operational data systems can support DSN activities.

In support of this task, the Contractor shall:

1. Ensure that the data processing subsystems adhere to DSMS operability standards as documented in JPL DSMS 820-019, *DSMS Interface Design Standard*.
2. Provide status reports of all data processing subsystems to the DSMS Engineering and Operations Program Offices:
  - a. A weekly status report of significant events on the operational performance.
  - b. A detailed, monthly status report of operational performance and trend analysis.
3. Provide general DSN Engineering support as described in Section 4.1, DSN Engineering, as appropriate.

#### **4.1.5 Communications System Network Engineering**

The Communications System Network Engineering task provides engineering technical support of the DSMS Ground Communications System (GCS) as defined in DSMS 820-061. The scope extends from the GCS input interfaces at the DSCCs to the input of the user subsystems at the project Mission Operations Centers or other facilities.

In support of this task, the Contractor shall:

1. Provide general DSN Engineering support as described in Paragraph 4.1, as applicable to Communications System Network Engineering.

#### 4.1.6 Test Engineering

A key element of the DSMS Service Capabilities Development (SCD) process is the test process. A part of the entire development life cycle of hardware and software, test engineering takes on critical importance during the acceptance testing.

During the development phase for DSN hardware and software, operations personnel will work with DSMS Engineering task personnel to learn the complete operational capabilities of the deliverable and to provide test design and requirements inputs.

During the pre-acceptance test phase, the Test Engineer will observe engineering testing and “rehearsals” of the acceptance test procedures. Operations personnel will also review and critique—individually or via peer review—key engineering test documents such as the release description document (RDD), software operator's manual (SOM), and software test plan (STP)/system integration and test plan (SITP).

During the acceptance test phase, the operations Test Engineer will perform the tests required in the DSMS test documents, evaluate software safety, and perform other tests that the Test Engineer deems necessary. The Test Engineer will also document test results and observed anomalies, using the DSMS anomaly reporting system. The Test Engineer will support and present at test readiness reviews, consent-to-ship reviews, and DSMS delivery reviews.

Test Engineers must be versed in test theory, test methodologies, software safety, and the fundamentals of design and operations for hardware and/or software (as appropriate to the task).

In support of this task, the contractor shall:

1. Provide tools to analyze software complexity and test coverage.
2. Support DSMS Engineering in pre-acceptance test phase.
3. Participate in test plan reviews by analyzing the test procedure documents in terms of complexity, function points, coverage, and other industry standard measures.
4. Participate in DSMS development-to-operations-process reviews as documented in DSMS 813-101.
5. Perform acceptance tests as documented in released test plans.
6. As required, generate additional test plans, including an operations test plan, modifications to DSMS test documents, and modifications to procedures.
7. Schedule tests and determine resource requirements (test equipment, station equipment, and personnel), based on delivered or draft test plans.
8. Document test results in test reports per DSMS 813-112, *DSMS Testing Standards and Guidelines*.

9. Document anomalies, using the DSMS anomaly reporting system.
10. Work with DSN Network Engineers to analyze and respond to anomalies.

This task has a special provision:

1. The task shall be performed by trained test engineers who are familiar with industry-standard or IEEE hardware and/or software development and test processes.
2. Test Engineers shall be versed in test methodologies, test theory, and the fundamentals of design and operations for hardware and/or software.

## 4.2 Product Development and Sustaining Engineering

The complete set of DSMS hardware and software products is identified in the 820-061 Database. The Contractor will have sustaining responsibility for specific subsets of these items. The responsibility may be assigned at three levels:

- **Subsystem level:** The Contractor will be responsible for designing the subsystem, designing its components, and for implementing any sustaining modifications. The Contractor will have subsystem engineer (SSE) and assembly-level cognizant development engineer (CDE) responsibility.
- **Assembly (hardware item or software program) level:** The Contractor will be responsible for designing and sustaining the assembly, according to subsystem-level plans. The Contractor will have assembly-level CDE responsibility.
- **Sustaining level:** The Contractor will provide sustaining support to a JPL CDE for a specific assembly.

For data processing subsystems, the Contractor's sustaining responsibilities are associated with legacy systems that will eventually be phased out of the Network. The DSMS Engineering Program Office will periodically evaluate the assignment of new sustaining responsibilities.

In support of this task, the Contractor shall:

1. Perform product engineering assignments, in accordance with Appendix I, Product Engineering Assignments.
2. For subsystem-level assignments:
  - a. Generate and review subsystem designs and associated documents, per DSMS 813-101.
  - b. Generate interface agreements and obtain approval of them.
  - c. Generate DSMS Deployment Plans (DDPs), per DSMS Document 813-106, *Preparation Guide for Implementation and Quality Plans*, for major subsystem upgrades and obtain approval of them.
  - d. Transfer to operations, in accordance with DSMS Document 813-125, *DSN Hardware Transfer and Delivery Procedures*; and 813-126, *DSN Software Transfer and Delivery Procedures*.

3. For assembly-level assignments:
  - a. For assignments at the assembly level but not the subsystem level, obtain approval of delivery/modification schedules from the cognizant Service System Manager (SSM).
  - b. Produce assembly designs and associated documentation
  - c. Deliver any modkits associated with the assembly
  - d. Provide all documentation and training as required by DSMS documents 813-125 and 813-126.
4. For sustaining, support-level assignments:
  - a. Prepare documentation and modkits associated with modifications, as required by DSMS documents 813-125 and 813-126.

#### **4.2.1 Facilities Development and Sustaining**

The Contractor will provide SSE and CDE functions for the DSN Technical Facilities Subsystem and for construction-of-facilities (CoF) projects. This task includes:

- Developing new and modified capabilities in DSN Facilities
- Sustaining engineering support for existing DSN Facilities
- Technical oversight of certain CoF projects

Facilities engineering encompasses:

- Power
- Lighting
- Grounding
- Site and civil construction
- Heating, ventilation, air conditioning (HVAC)
- Fire suppression and detection
- Nitrogen systems

In support of this task, the Contractor shall:

1. Provide development engineering of all DSCC facilities, infrastructure, and antenna facilities
  - a. Perform analysis, design, fabrication, construction management, installation, verification, testing, evaluation, and documentation of existing or new equipment or facilities.
2. Provide engineering support and oversight of DSN CoF projects.
3. Develop or modify antenna support equipment or assemblies, according to DSMS documents 813-101 and 813-202.
4. Release design drawings and documentation, in accordance with DSMS 813-203-vol-1, *DSN Drawing Format and Content Standards: Volume 1, Equipment*, and DSMS 813-203-vol-2, *DSN Drawing Format and Content Standards: Volume 2, Facilities*.

5. Interact with other engineers for design development and project planning.
6. Conduct design reviews of all CoF-funded projects, in accordance with NPG 8820.2, *NASA Facility Projects Implementation Handbook (FPIH)*.

This task has the following special provisions:

1. This task shall be implemented by staff qualified for the following functions, as described in Appendix J, Contractor Staff Roles:
  - Facilities Design Engineer
  - Electrical Engineer
  - Mechanical Engineer
  - Civil Engineer
  - Designer and drafter
  - Geographic Information System (GIS) specialist

#### **4.2.1.1 Facilities Subsystem Engineering**

The Contractor will provide Facilities Subsystem Engineering by developing facilities-subsystem-level requirements and activities. The Facilities SSE will provide input into facilities concepts and update all planning documentation as appropriate.

In support of this task, the Contractor shall:

1. Identify potential facilities projects, using a computerized-maintenance management system (CMMS), facility condition assessment, and backlog of maintenance and repair (BMAR) report.
2. Develop the master-planning vision, criteria, and drivers for facilities, in coordination with the DSN CoF Program Office and the DSCCs, by providing:
  - a. Data collection and analysis
  - b. Assessment of facility inventory conditions
  - c. DSCC land constraints
  - d. Assessment of environmental, utility, and transportation inventories
  - e. Assessment and forecast of facility demands and potential land-use alternatives
3. Provide inputs for facilities and antenna support equipment functional requirements.
4. Support the DSMS Engineering Office in generating yearly facilities call-response metrics.
5. Contribute and support special studies.
6. For facilities, help CDEs assess and define user needs, utilization, and disposal planning and execution.
7. Provide inputs to NASA real property database, for the construction and modification of facilities.



8. Establish, populate, and maintain the DSN GIS database on a server that is accessible to authorized DSN users.
9. Host NASA's Facilities Project Management System (FPMS) software on a server that is accessible to authorized DSN users.

#### **4.2.1.2 Facilities Design Engineering**

The Contractor will provide CDEs to support Facilities Design Engineering in the following:

- Power
- Lighting
- Grounding
- Site and civil construction
- HVAC
- Fire suppression and detection
- Nitrogen systems

In support of this task, the Contractor shall:

1. Develop requirements, and support functional requirement reviews and preadvertisement construction reviews.
2. Provide input to the DSMS Operations and Engineering program offices for siting new facilities.
3. Support the development of facility concept studies.
4. Develop requirements for selecting architect and engineering (A&E) services and provide them to the JPL A&E Selection Board.
5. Oversee facility construction and construction contracting.
6. Perform construction project management, and develop and execute facility activation plans for all new construction and facility modifications.
7. Perform the Project Definition Rating Index (PDRI) assessment for CoF-related facilities and antenna-support-equipment projects, and generate PDRI scores.
8. Request authority to advertise from DSN CoF Program Office for CoF-related projects.
9. Prepare and submit flash reports of bids.
10. Generate statements of work for CoF projects, using the Specifications-Kept-Intact (SPECSINTACT) System.
11. Interface with operations and maintenance personnel, users, and subsystems engineers, to ensure their coordination with other DSN subsystems and assemblies.
12. Support the facility SSEs in all aspects of Facilities and Antenna Support Equipment Systems, to ensure asset availability.
13. Generate and update antenna-support-equipment-related and facilities-related documents, interface agreements, drawings, specifications, functional requirements documents, schedules, and plans.

#### 4.2.2 Test Product Development Engineering

The Contractor will develop the software required to analyze and validate system performance. Whenever a new capability is delivered to the network, the Contractor will validate the performance of the new capability in terms of its stability, bit error rates, and other system performance measurements, using the System Performance Test Assembly (SPTA). Additionally, the Contractor will analyze problems or anomalous conditions, using JPL and Contractor software tools. This task provides for the development of Contractor tools and SPTA. The contractor will also provide supporting hardware for the network.

The Contractor will develop, maintain, deliver, and archive the software in accordance with the SCD process and appropriate required DSMS documents.

In support of this task, the Contractor shall:

1. Develop System Performance Test and other test capabilities that are required for operations and maintenance support.
  - a. Generate SPT software and hardware requirements and review them in accordance with DSMS Document 813-101.
  - b. Document SPT operations procedures, in accordance with DSMS Document 810-001.
  - c. Procure required and approved SPT hardware.
  - d. Test and transfer the hardware and software, according to DSMS documents 813-125 and 813-126.
  - e. Develop databases and applications software to assist the DSN facilities in performing operations and maintenance tasks.
  - f. Develop and document analysis support software.
  - g. Archive all developed software in Software Production Management and Control (SPMC).
  - h. Sustain the software by adding new capabilities as required or requested by DSN personnel, and as approved by the DSMS Operations Program Office.

## 5 DIRECTED EFFORTS/TASKS

---

The Contractor will provide the necessary labor, materials, and facilities required to support directed efforts and tasks:

- Product development and sustaining in support of Deep Space Mission System (DSMS) engineering
- Construction, restoration, removal, relocation, maintenance, installation, or alteration of existing facilities funded by NASA's Construction of Facilities (CoF) program
- Short-term work—support of planned implementation of new Deep Space Network (DSN) capabilities that have schedule constraints and that are temporary in nature. This support includes emergency antenna or facility maintenance support and extended downtime where onboard skills or resources must be augmented.
- Real-time or short-term variations in the scope of the task description document (TDD) or JPL-directed support
- Temporary use of Contractor support not covered in the task description document
- Emergency antenna or facility maintenance support and extended downtime where onboard skills or resources must be augmented

### 5.1 Product Development and Sustaining

This task provides the necessary labor, materials, and facilities needed to support DSN engineering development and sustaining activities that are short-term in nature. The Contractor will be tasked to support these activities via a contract work order (CWO) for the duration of the contract year defined in the annual operating plan (AOP). If the work extends beyond the AOP contract year, this work will be included in the JPL budget guidelines and in the AOP for the following contract year.

In support of this task, the Contractor shall:

1. Provide task estimates within the time specified in the contract technical manager's (CTM's) request. Estimates shall include staffing requirements, costs, and schedules for accomplishing the specified work.
2. Perform the work after receiving JPL contract negotiator authorization to incur cost while the CWO is being processed.
3. Provide deliverables in accordance with CWO specifications.
4. Provide monthly reports of schedule, technical, and cost performance to the CTM and the JPL (or JPL subcontractor) task manager.

## 5.2 Construction and Major Modification to Existing Facilities

CoF includes minor facility projects such as revitalization, minor construction, environmental compliance and restoration projects, and major modifications to existing facilities.

When new construction and major modifications to existing facilities require use of Contractor expertise in these areas, the JPL contract negotiator, at the request of the CTM, may issue CWOs to the Contractor to perform this work.

The CWOs will list those projects within each program, as shown on the NASA HQ DIV Form 800, *NASA Minor Facilities Projects—Summary Brief Project Document (SBPD)*, and the approved funding as authorized by NASA Form 506A, *Resources Authority Warrant*. (Other specific submittals may be required based upon the specific language in the annual call for CoF projects, e.g., EconPAK economic analyses.) The CWO may also authorize the Contractor to use subcontractors.

In support of this task, the Contractor shall:

1. Establish and maintain a procedure for coordinating with and keeping the Contracting Officer and CTM informed about facility management, including the process for acquiring facilities.
2. Implement projects under the authority of the SBPD to the intent and scope set forth in NASA Form 1509, *Facility Project Brief Project Document*, as approved by the Director, Facilities Engineering Division, or designee.
3. Ensure that environmental compliance and restoration (ECR) projects implemented under the authority of the ECR-SBPD conform to the intent and scope set forth in the project approval document, as approved by the NASA HQ Director, Environmental Management Division (Code JE), and placed in a CWO by the Contracting Officer.
4. Comply with resource allocations. The amount shown as the “Approved Program Plan” in the SBPD or ECR-SBPD indicates the total resources available for projects by the related NASA Form 506A. At no time shall fiscal obligations exceed this amount. The intent and scope of the project shall remain as indicated on the approved NASA Form 1509.
5. Comply with the criteria, procedures, and reporting requirements for ongoing CoF projects, as set forth in NPG 8820.2, *Facility Project Implementation Handbook*.
6. Comply with all NASA issuances applicable to the construction or major modification of government-owned and Contractor-leased facilities. These issuances are enumerated in Appendix C, Applicable Documents. Deviations, variations, and exceptions to requirements in these documents must be approved by the NASA HQ Director, Facilities Engineering Division (Code JX), through the DSMS CoF manager and the CTM.

7. Ensure that all facilities-related computer-aided design (CAD) data complies with the National CAD Standard (NCS) published by the National Institute for Building Sciences (NIBS).

### 5.3 Short-Term Work

The Contractor will perform short-term work when the duration of the requirement can be estimated with a high degree of accuracy. The Contractor's work requirement may be for staffing, procurements, or both. At the request of the CTM, the JPL contract negotiator will issue a CWO to the Contractor to perform this work. Short-term work will not normally be considered for inclusion in the next revision of the TDD because of its finite duration.

In support of this task, the Contractor shall:

1. Provide task estimates within the time specified in the CTM request. Estimates shall include staffing requirements, costs, and schedules for accomplishing the specified work.
2. Coordinate with the CTM in preparing a CWO.
3. Provide deliverables in accordance with CWO specifications.
4. Provide monthly reports of schedule, technical, and cost performance to the CTM.

### 5.4 Changes to the TDD

After the current AOP is approved, the TDD may change because of changes in requirements for JPL-directed support or changes in the level of support required by TDD tasks. The changes will normally involve staffing and be of sufficient duration to be included in the next revision of the TDD.

In support of this task, the Contractor shall:

1. Provide task estimates within the time specified in the CTM request. Estimates shall include staffing requirements, costs, and schedules for accomplishing the specified work.
2. Perform the work as directed by the JPL contractor negotiator.
3. Provide deliverables in accordance with CWO specifications.
4. Provide monthly reports of schedule, technical, and cost performance to the CTM.
5. Document the CWO for inclusion in the next revision of the AOP and TDD.

### 5.5 Emergency Requirements

Emergencies in the DSN may occur at any time, for example, because of equipment failures or unplanned facilities maintenance. Emergencies may require the Contractor to use resources outside the scope of the AOP; a CWO

will be issued to cover such costs. CWOs of this type will be for a specific one-time requirement and will not be included in the next revision of the TDD.

In support of this task, the Contractor shall:

1. Perform the work that is within the scope of the AOP after receiving technical direction from the CTM. The Contractor shall perform the work that is outside the scope of the AOP after receiving technical direction from the JPL contract negotiator.
2. Record actual expenditures based on CTM technical direction.
3. Provide task estimates within the time specified in the CTM request. Estimates shall include staffing requirements, costs, and schedules for accomplishing the specified work.
4. Coordinate with the CTM in preparing a CWO to cover work performed by the Contractor.
5. Provide deliverables in accordance with CWO specifications.
6. Provide monthly reports of schedule, technical, and cost performance to the CTM.

## 6 APPENDIX A: ACRONYMS AND OTHER ABBREVIATIONS

Table 6-1 expands acronyms, initializations, and other abbreviations used in the body of this document.

Table 6-1: Acronyms and Other Abbreviations

Term	Expansion
A&E	architect and engineering
AFB	air force base
AMMOS	Advanced Multi-Mission Operations System
AoE	area of emphasis
AOP	annual operating plan
AR	anomaly report
AT	acceptance test
AT	acceptance testing
BMAR	backlog of maintenance and repair
BRT	business and restricted technology
BWG	beam waveguide
CAD	computer-aided design
CCB	change control board
CCF	Central Coordinating Facility
CCR	California Code of Regulations
CCT	Central Communications Terminal
CDE	Cognizant Development Engineer
CDE	cognizant development engineering
CDRL	Contract Data Requirements List
CDR	central data recorder
CDR	Critical Design Review
CDSCC	Canberra Deep Space Communication Complex
CFC	chlorofluorocarbon
CFMA	Critical Facilities Maintenance Assessment
CMF	Complex Maintenance Facility
CMMS	computerized-maintenance management system
CNC	computer numerical control
Code JE	NASA Energy and Environmental Management Division
CoF	Construction of Facilities
CPR	cardiopulmonary resuscitation
CRDE	Complex Research-and-Development Engineer
CSP	Certified Safety Professional
CTM	Contract Technical Manager

Table 6-1: Acronyms and Other Abbreviations

Term	Expansion
CTT	Compatibility Test Trailer
CVS	central voice switch
CVT	central voice terminal
CWO	contract work order
DCT	design control tables
DDOR	delta-differenced one-way ranging
DDP	DSMS Deployment Plans
DLF	DSN Logistics Facility
DMD	Data Monitor Display
DMR	detailed mission requirements
DOD	Department of Defense
DOM	Distributed Objects Manager
DPDS	DSMS Product Distribution System
DR	discrepancy report
DRMS	Discrepancy Reporting Management System
DSCC	deep-space communications complex
DSMS	Deep Space Mission System
DSN	Deep Space Network
DSO	Data Systems Operations
DSOCC	Deep Space Operations Control Center
DSPA	Data System Processing Area
DSR	daily status report
DSS	deep-space stations
DTF	Development and Test Facility
DTR	detailed technical review
EAR	U.S. Export Administration Regulations
ECC	Emergency Control Center
ECM	engineering change management
ECO	engineering change order
ECR	engineering change requests
ECR	environmental compliance and restoration
EDCATS	Education Program Data Collection and Evaluation System
EIS	environmental impact statement
FAA	Federal Aviation Administration
FBI	Federal Bureau of Investigation
FIP	facility implementation plan
Force Con	Force Condition
FPIH	Facility Projects Implementation Handbook
FPMS	Facilities Project Management System



Table 6-1: Acronyms and Other Abbreviations

Term	Expansion
FTS	frequency and timing subsystem
FY	fiscal year
GAVRT	Goldstone–Apple Valley Radio Telescope
GCF	Ground Communications Facility
GCS	Ground Communications System
GDSCC	Goldstone Deep-Space Communications Complex
GFE	Government-furnished equipment
GFP	Government-furnished property
GIF	Ground Interface Facility
GIS	geographic information system
GISO	General Industry Safety Orders
GNIMS	Goldstone NTC Inter-Range Microwave System
GOF	Government-owned facility
GSA	General Services Administration
GSFC	Goddard Space Flight Center
GSSR	Goldstone Solar System Radar
HAZMAT	hazardous material
HBI	hydrostatic bearing instrumentation
HEF	high-efficiency antenna
HEO	high-Earth-orbit
HPTTF	High-Power Transmitter Test Facility
HSB	high-speed BWG
HVAC	heating, ventilation, and air conditioning
IDR	intermediate data record
IF	intermediate frequency
IND	Interplanetary Network Directorate
ISDN	integrated services digital network
ITAR	International Traffic in Arms Regulations
ITS	information technology security
JPL	Jet Propulsion Laboratory
JURAP	joint user-resource-allocation planning
KSC	Kennedy Space Center
LAN	local area network
LEO	low-Earth orbit
LPG	liquefied petroleum gas
LRE	lowest-replaceable element
MCC	modified configuration control
MCG	Mojave Coordination Group
MDAP	mission-data acquisition planning

Table 6-1: Acronyms and Other Abbreviations

Term	Expansion
MDSCC	Madrid Deep Space Communication Complex
MERR	Mission Event Readiness Review
MIA	Monitor Interface Assembly
MIL	Merritt Island Launch (Support)
modkit	modification kit
MOU	memorandum of understanding
MP	Military Police
MSDS	material safety data sheet
MSN	NASA-defined mission data
MTTR	mean time to repair
NASA	National Aeronautics and Space Administration
NCS	National CAD Standard
NEC	National Electric Code
NEPA	National Environmental Policy Act
NFPA	National Fire Protection Association
NIBS	National Institute for Building Sciences
NIS	network information services
NISN	NASA Information Services Network
NIST	National Institute of Standards and Technology
NMC	Network Monitor and Control
NMO	NASA Management Office
NOCC	Network Operations Control Center
NOCC-RT	NOCC real time
NOCT	Network Operations Control Team
NOP	network operations plan
NPD	NASA Policy Document
NPG	NASA Procedures and Guidelines
NRP	NASA Resource Protection
NSS	Network Support Subsystem
NTC	national training center
NTIA	National Telecommunications and Information Administration
NVP	Network VLBI Processor
NWTC	Naval weapons training center
O&M	operations and maintenance
ODF	orbit data file
ODS	ozone-depleting substance
OIC	officer in charge
OMM	operations and maintenance manual
OTP	operation test plan

Table 6-1: Acronyms and Other Abbreviations

Term	Expansion
PBO	Programmatic Biological Opinion
PCFS	PC field system
PDMS	Product Data Management System
PDCS	Preliminary Definition and Cost Review
PDR	Preliminary Design Review
PDRC	Preliminary Definition and Cost Review
PDRI	Project Definition Rating Index
PIT	project interface test
PLO	programmable local oscillator
POCC	Project Operations Control Center
POL	petroleum and oil lubricants
POP	program operating plan
PPE	personnel protective equipment
R&D	research and development
R&D PEM	Research & Development Project Element Manager
R/A	radio astronomy
RAP	resource allocation planning
RAPSO	Resource Allocation Planning and Scheduling Office
RAPT	Resource Allocation Planning Team
RARB	Resource Allocation Review Board
RASA	radio astronomy and special activities
RCM	Reliability-Centered Maintenance
RCRA	Resource Conservation and Recovery Act
REA	Registered Environmental Assessor
RF	radio frequency
RFI	radio-frequency interference
RFS	Radio Frequency Surveillance System
RMDC	radio-metric data conditioning
RNS	reliable network server
ROSA	Remote Operations Support Area
RSL	Reference Standards Laboratory
SAF	Spacecraft Assembly Facility
SBPD	Summary Brief Project Document
SCE	Southern California Edison
SCMT	service commitment process
SFG	special-function gateway
SFOF	Space Flight Operations Facility
SITP	System Integration Test Plan
SLE	space link extension

Table 6-1: Acronyms and Other Abbreviations

Term	Expansion
SOEs	sequences of events
SOP	standard operations procedure
SOW	statement of work
SPC	Signal Processing Center
SPECSINTACT	Specifications-Kept-Intact
SPMC	Software Production Management and Control
SPT	system performance test
SPTA	System Performance Test Assembly
SSE	Subsystem Engineer
SSF	software support file
SSM	Service System Manager
SVC	service capabilities development process
SVE	service execution process
SVLBI	space very-long-baseline interferometry
SVS	Station Voice Switch
SVT	Station Voice Terminal
TDD	task description document
TDDS	Tracking-Data Delivery System
TDS	Telemetry Delivery System
TIS	Telemetry Interface System
TMS	Telecommunications and Mission Systems
TMS	Telemetry and Mission Support
TPS	third-party software
TSS	Tracking Support Specialists
TTC&DM	tracking, telemetry, command, and data management
UPS	uninterruptable power supply
UWV	microwave subsystem
VOCA	Voice-Operational Communications Assembly
VLBI	very-long-base interferometry
WA	Workmanship Assurance
WBC	Wide Band Very Long Base Interferometry Correlator

## 7 APPENDIX B: GLOSSARY

Table 7-1 is a glossary that defines terms used in this document with special, limited, or specific meanings.

Table 7-1: Glossary

Term	Expansion
all	any and/or all
any	any and/or all
caretaker maintenance	the protection of exposed structural and mechanical surfaces
complex maintenance facility	a maintenance facility where the Contractor tests LREs and repairs or sends them to the vendor or , for JPL-designed assemblies, to JPL for repair.
contract	a mutually binding legal relationship obligating the seller to furnish the supplies or services (including construction) and the buyer to pay for them. It includes all types of commitments that obligate the Government to an expenditure of appropriated funds and that, except as otherwise authorized, are in writing. In addition to bilateral instruments, contracts include (but are not limited to) awards and notices of awards; job orders or task letters issued under basic ordering agreements; letter contracts; orders, such as purchase orders, under which the contract becomes effective by written acceptance or performance; and bilateral contract modifications. Contracts do not include grants and cooperative agreements covered by 31 U.S.C.6301, et seq. For discussion of various types of contracts, see the FAR Part 16.
Contractor	Capitalized, "Contractor" is the other party signing a contract with JPL (on behalf of NASA) to provide DSN O&M; "contractor" refers to a contractor in general.
corrective maintenance	The repair and restoration of equipment to service.
corrective maintenance, Level 1	Switching to backup equipment, when available, to restore data services and minimize data outages. Performed in situ by operators or technicians, 24 hour a day, seven days a week.
corrective maintenance, Level 2	The in situ diagnosing, troubleshooting, and replacing of failed assemblies or lower-replacement elements (LREs)
corrective maintenance, Level 3	maintenance of items that cannot be repaired in situ but instead require the capabilities of the Complex Maintenance Facility (CMF)
custodial maintenance	maintenance to ensure basic mechanical operation
including	including but not limited to
periodic maintenance	scheduled, routine maintenance
preventive maintenance	maintenance to prevent failures.
radio metric	data based on measurement of the RF carrier or modulated RF carrier. Includes Doppler phase, angles, range, and VLBI (DDOR)
reliability-centered maintenance	maintenance performed based on the probability of failure—a type of predictive maintenance
shall	the imperative; mandatory



## 8 APPENDIX C: APPLICABLE DOCUMENTS

Table 8-1 provides references for applicable documents cited in the body. Where the document is cited in a particular WBS, the WBS number is given. All documents in this table are included in the TDD by reference. Where the standards conflict, the more rigorous standard shall apply.

Table 8-1: Applicable Documents

WBS #	Doc No.	Title or Description
1.1.3	(various)	All NPG, NPD, and executive orders in this appendix.
1.1.3 2.1.3	CCR Title 8	General Industrial Safety Orders (GISO)
1.1.3 1.1.4 2.1.3	JPL D-560	JPL Standard for Systems Safety
1.1.3 2.1.3	NPD 8710.2	NASA Safety and Health Program Policy
1.1.3 2.1.3	NPG 8715.1	NASA Safety and Health Handbook Occupational Safety and Health Programs
1.1.3 2.1.3	NPD 8621.1	NASA Mishap and Close Call Reporting
1.1.4 2.1.3 2.5.2	(various)	Cal/OSHA requirements
1.1.4	D-560	JPL Standards for Systems Safety
1.1.5 5.2	NPD 8820.3	Facility Sustainable Design
1.1.5 2.1.4	NPD 8500.1*	NASA Environmental Management
1.1.5 2.1.4	NPG 8820.3*	Pollution Prevention
1.1.5 2.1.4	NPG 8830.1*	Affirmative Procurement of Environmentally Preferable Products
1.1.6 2.1.2 3.1.1.2	NPG 1620.1*	Security Procedures and Guidelines, subject to approved NASA code X waivers
1.1.6 2.1.2	DOD 5220.22-M & Supplements	National Industrial Security Program Operating Manual (NISPOM)
1.1.6 2.1.2	----	Presidential Decision Directives
1.1.7	D-23140	DSMS Information Technology Security Policy
1.1.7	D-17896	DSMS Information Technology Security Requirements for Computer Systems
1.1.7	D-7155	JPL IT Security Requirements for Computer Systems
1.1.7	D-7223	JPL IT Security Requirements

Table 8-1: Applicable Documents

WBS #	Doc No.	Title or Description
1.1.7 3.1.1.2	NPG 2810.1*	Security of Information Technology
1.3	NPD 8800.14	Policy for Real Property Management
1.3 2.5.1.11	DSMS 890-165	Directory of DSCC Facilities: the Goldstone Gold Book
1.3 5.2	NPG 8800.15	Real Estate Management Program Implementation Manual
1.6	NPG 8000.4	Risk Management Procedures and Guidelines
2 2.2 3.1.4.1	DSMS 810-005	DSMS Telecommunications Link Design Handbook
2.1.1 2.1.8 2.1.10	----	MOU between DOD and NASA for Compatible Operations in the Mojave Desert Area ("Mojave Coordination Agreement")
2.1.2	NPD 1600.2	NASA Security Policy
2.1.2	----	The National Resources Protect Act, subject to Code X agreed-to waivers
2.1.3	NPD 8621.1*	NASA Mishap and Close-Call Reporting, Investigation, and Recordkeeping
2.1.3	NPG 8621.1	NASA Procedures and Guidelines for Mishap Reporting, Investigating, and Recordkeeping
2.1.3	NPD 8710.1	Emergency Preparedness Program
2.1.3	NPD 8710.5*	NASA Safety Policy for Pressure Vessels and Pressurized Systems
2.1.3	NPG 8715.2	NASA Emergency Preparedness Plan Procedures and Guidelines
2.1.3	NPG 8715.3	NASA Safety Manual with Changes through Change 1, 6/19/02
2.1.3	NASA-STD-8719.9	Standard for Lifting Devices and Equipment
2.1.3	NASA-STD-8719.7	Facility System Safety Guidebook
2.1.3	NASA-STD-8719.11	NASA Safety Standard for Fire Protection
2.1.3	(various)	National Fire Protection Association (NFPA), NASA requirements for fire protection
2.1.4	NPG 8580.1*	Implementing The National Environmental Policy Act And Executive Order 12114
2.1.4	----	The Resource Conservation and Recovery Act (RCRA)
2.1.4	----	The Clean Air Act
2.1.4	----	The Endangered Species Act
2.1.4	----	The National Historic Preservation Act
2.1.4	Executive Order 11514	Protection and Enhancement of Environmental Quality
2.1.4	Executive Order 11593	Protection and Enhancement of the Cultural Environment



Table 8-1: Applicable Documents

<b>WBS #</b>	<b>Doc No.</b>	<b>Title or Description</b>
2.1.4	Executive Order 11988	Floodplain Management
2.1.4	Executive Order 12088	Federal Compliance with Pollution Control Standards
2.1.4	Executive Order 12580	Superfund Implementation, Amended by 13016 and 12777
2.1.4	Executive Order 12843	Procurement Requirements and Policies for Federal Agencies of Ozone-Depleting Substances
2.1.4	Executive Order 12856	Federal Compliance with Right-to-Know Laws and Pollution Prevention Requirements
2.1.4	Executive Order 12941	Seismic Safety of Existing Federally Owned or Leased Buildings
2.1.4	Executive Order 13007	Indian Sacred Sites
2.1.4	Executive Order 13101	Greening the Government Through Waste Prevention, Recycling, And Federal Acquisition
2.1.4	Executive Order 13112	Invasive Species
2.1.4	Executive Order 13132	Federalism
2.1.4	Executive Order 13148	Greening the Government Through Leadership in Environmental Management
2.1.4	Executive Order 13149	Greening the Government Through Federal Fleet and Transportation Efficiency
2.1.4	Executive Order 13150	Federal Workforce Transportation
2.1.4	Executive Order 13175	Consulting and Coordinating with Indian Tribal Governments
2.1.4	Executive Order 13186	Responsibility for Federal Agencies to Protect Migratory Birds
2.1.4	Executive Order 13211	Actions Concerning Regulations that Significantly Affect Energy Supply Distribution or Use
2.1.4	Executive Order 13221	Energy Efficient Standby Power Devices
2.1.4	NPG 8830.1	Affirmative Procurement of Environmentally Preferable Products
2.1.5	42 USC 8251-8287	National Energy and Water Conservation Policy Act, as amended by the Energy Policy Act of 1992, P.L. 102-486
2.1.5	Executive Order 13123	Greening the Government Through Efficient Energy Management
2.1.5	10 CFR 434	Federal Energy Building Code
2.1.5	CCR Title 24	Energy Efficiency Cde
2.1.5	NPG 8570.1	Energy Efficiency and Water Conservation Technologies and Practices

Table 8-1: Applicable Documents

WBS #	Doc No.	Title or Description
2.1.5 5.2	NPG 7120.5*	NASA Program and Project Management Processes and Requirements
2.1.9	NPD 1383.1	Release and Management of Audiovisual Products and Services
2.1.9	NPD 1383.2	NASA Assistance to Non-Government Entertainment-Orientated Motion Picture, Television, Video, and Multimedia Production/Enterprises and Advertising
2.1.9	NPG 1387.1	NASA Exhibits Program
2.1.9	NPD 1392.1	Conduct of the NASA Education Program
2.2 3.1.7	DSMS 842	Standard Operating Procedures
2.2 3.1.1.1 3.1.2 3.1.5.2 3.1.6 3.2.3 4.1	DSMS 841-001	DSN Standard Operations Plan
2.3.1	DSN-STD-1015	Welding Structural Steel
2.3.1 2.3.3	DSN-STD-1006	Painting or Thermal Coating --DSN Antennas and Supporting Structures
2.3.4 2.4.2	NPD 8730.1	Metrology and Calibration
2.4 3.2.2 3.2.3 3.2.4 4.1 4.1.5 4.2	DSMS 820-061	DSMS Subsystem, Configuration Item, and Responsibility Definition
2.4 3.2.4	DSMS 814-007	DSN Maintenance Program
2.4 4.1.3	DNS 9442211	DSN Top Assembly Drawing
2.4	ISO 9001-2000	Quality Management Systems—Requirements
2.5 5.2	NPG 8831.2*	Facilities Maintenance Management
2.5 5.2	NPD 8831.1*	Management of Facilities Maintenance
2.5 3.2.4	NPD 8720.1	NASA Reliability and Maintainability (R&M) Program
2.5.1.3	NFPA 70	National Electric Code
2.5.1.3	NFPA 70B	Recommended Practice for Electrical Equipment Maintenance
2.5.1.3	NFPA 70E	Standard for Electrical Safety Requirements for Employee Workplaces

Table 8-1: Applicable Documents

WBS #	Doc No.	Title or Description
2.5.1.5	22 CCR 64683	
2.5.1.5	22 CCR 64684	
2.5.1.8	8010-20B	California Department of Transportation Specification for Paint, Waterborne Traffic Line, White, Yellow, and Black
2.5.1.10	Title 27 CCR	California Integrated Waste Management Board
2.6.1	99-720-149	GAVRT Memorandum of Understanding
2.7.1	DSMS 874-021	Workmanship Assurance Program for Goldstone DSCC
2.7.1	DSMS 874-012	Quality Assurance Program Plan for the Deep Space Network Hardware.
3.1.1.1	DSN 842-50-311	DSN Discrepancy Reporting Policy and Operations/Management of the Discrepancy Reporting Management System
3.1.1.1	SOP 842-179	DSN Real and Near-realtime Coordination Procedure
3.1.1.1 3.2.3	DSMS 820-13	DSN System Requirements—Detailed Interface Design
3.1.4.2	SOP 842-50-31	Standard Use of the Discrepancy Reporting System
3.1.7	DSMS 814-004	Preparation Guide for DSMS Operations Procedures
3.2.1	DSMS 814-005	DSN Flight Interface Compatibility Design Handbook
3.2.2 4.1.1	DSMS 813-023	DSMS Configuration Management Procedures
3.2.2 4.2 4.2.2	DSMS 813-125	DSN Hardware Transfer & Delivery Procedures
3.2.2 4.2 4.2.2	DSMS 813-126	DSN Software Transfer & Delivery Procedures
3.2.3	DSMS 820-013	DSMS External Interface Specifications
3.2.3 4.1.4	DSMS 820-016	DSMS Subsystem Software Interfaces
3.2.3	DSMS 820-017	DSMS Detailed Hardware Interfaces
3.2.3 3.2.4 4.1.1	DSMS 813-021	TMOD DSMS Document Process Procedures
3.2.3 4.1.4	DSMS 820-019	DSMS Drawing Process and Procedures
3.2.3 4.1 4.2.2	DSMS 810-001	DSMS Documentation Structure, Standards, and Definitions
4.1 4.1.6 4.2 4.2.1 4.2.2	DSMS 813-101	Guideline for SCD Reviews
4.1.1	DSMS 813-203	DSN Drawing Format and Content Standards: Vol. 1, Equipment

Table 8-1: Applicable Documents

<b>WBS #</b>	<b>Doc No.</b>	<b>Title or Description</b>
4.1.1	DSMS 813-022	TMOD DSMS Document Process Procedures
4.1.1 4.2.1	DSMS 813-202	Design Requirements for Deep Space Network Equipment
4.1.1	DSMS 820-019	DSMS Interface Design Standard
4.1.6	NASA-STD-8719.13	Software Safety
4.1.6	813-112	DSMS Testing Standards and Guidelines
4.2	DSMS 813-011	DSMS Service Capability Development Process
4.2.1 5.2	NPG 8820.2	Facility Project Implementation Handbook
5.2	NASA form 800	NASA Minor Facilities Projects—Summary Brief Project Document (SBPD)
5.2	NASA form 506A	Resources Authority Warrant
5.2	NASA forms 1509, 1510	Facility Project Brief Documents
5.2	NPD 8800.14	Policy for Real Property Management
5.2	NPD 8820.2	Design and Construction of Facilities
5.2	----	National CAD Standard (NCS)

\* Denotes conditional acceptance. Please see contract source for application conditions.

## 9 APPENDIX D: GDSCC MAP

---

Figure 9-1 is a map of the GDSCC and vicinity.



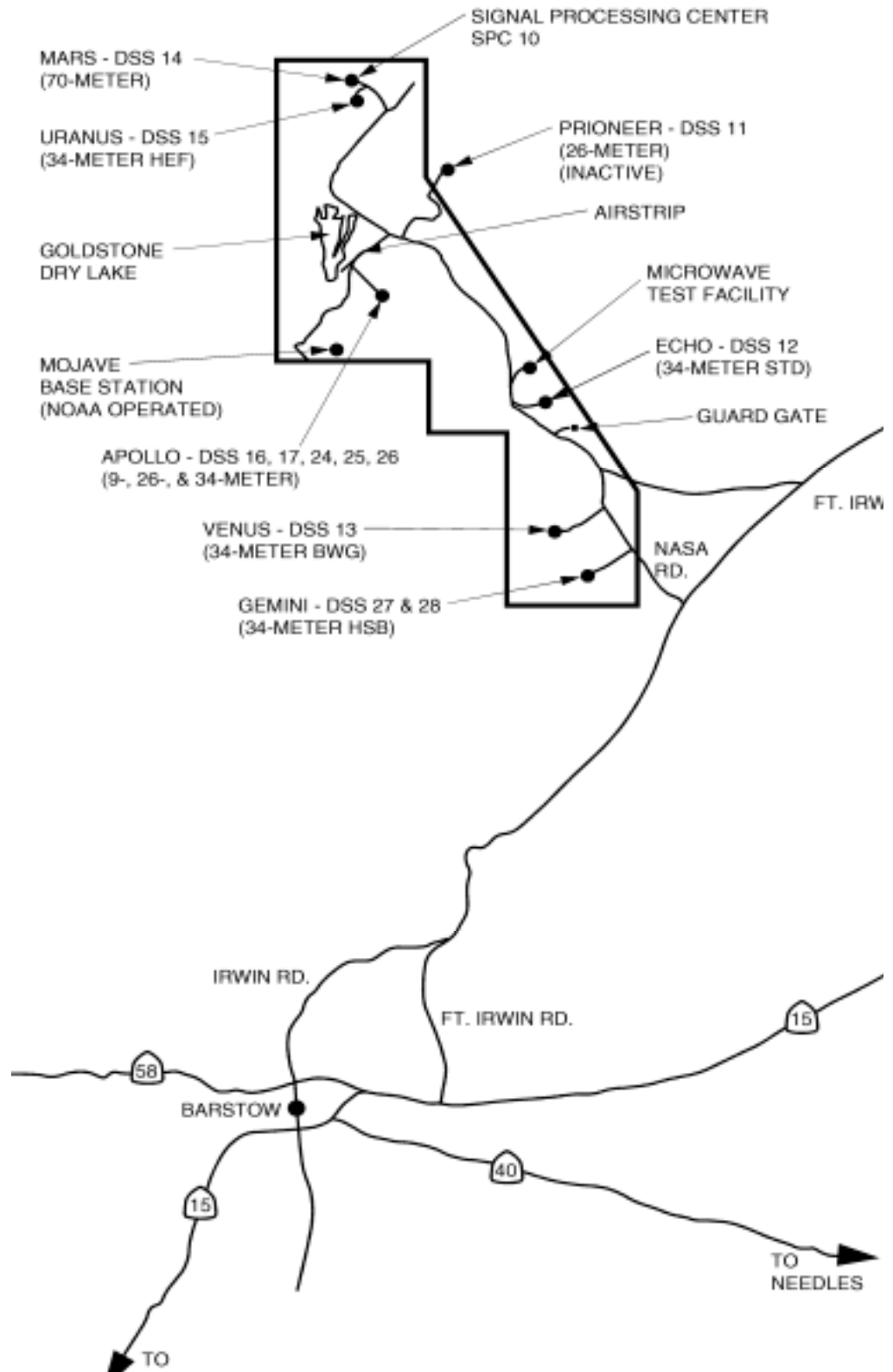


Figure 9-1: GDSCC and vicinity





## 10 APPENDIX E: DSMS PROCESSES

---

Figure 10-1 is an overview diagram of DSMS processes. Some of these processes are describe in more detail in subsequent appendixes.



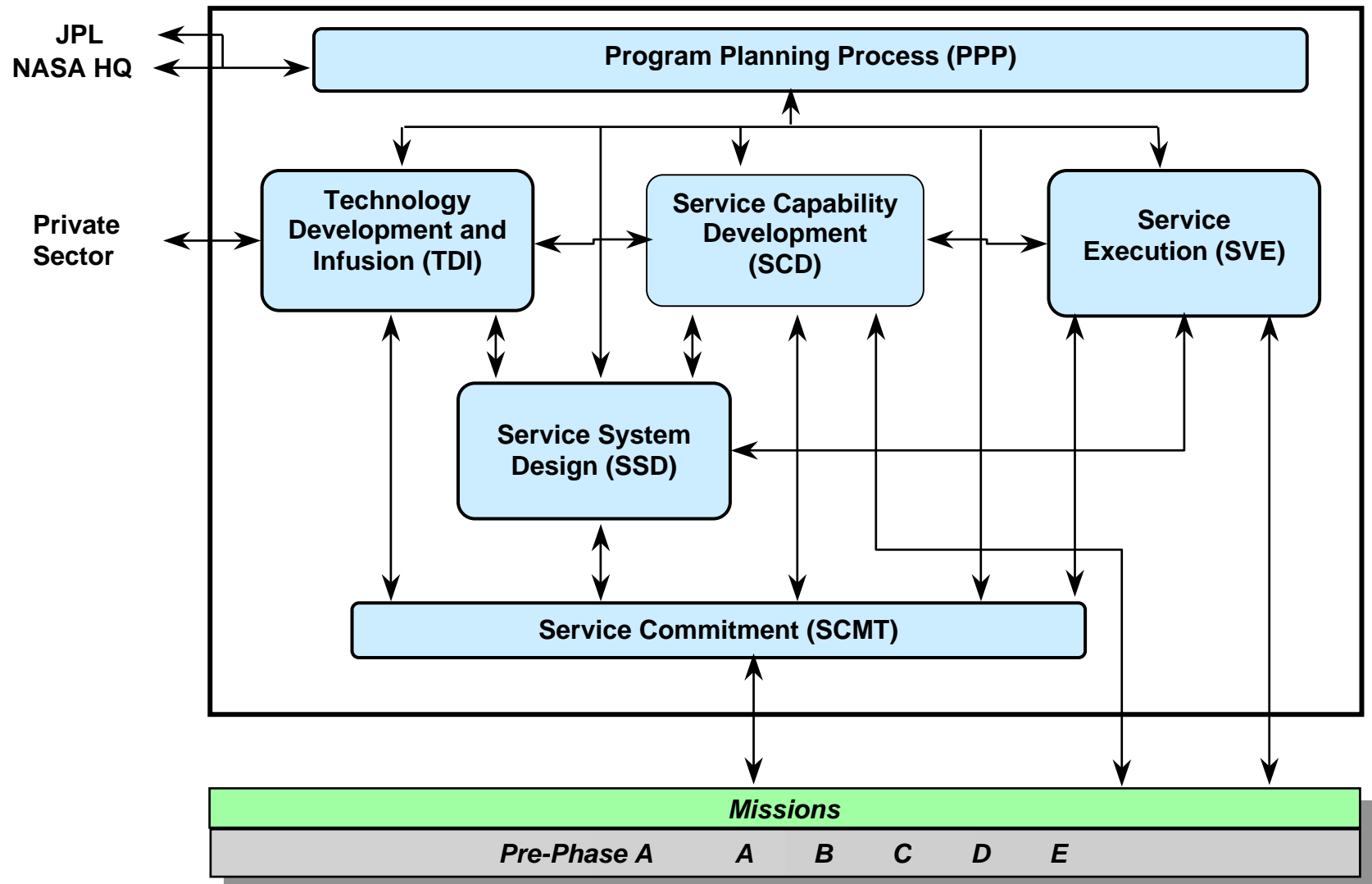


Figure 10-1: DSMS Processes



## 11 APPENDIX F: SERVICE COMMITMENT PROCESS

---

Figure 11-1 is a diagram of the service commitment process (SCMT) that shows its inputs, outputs, controls, and resources.



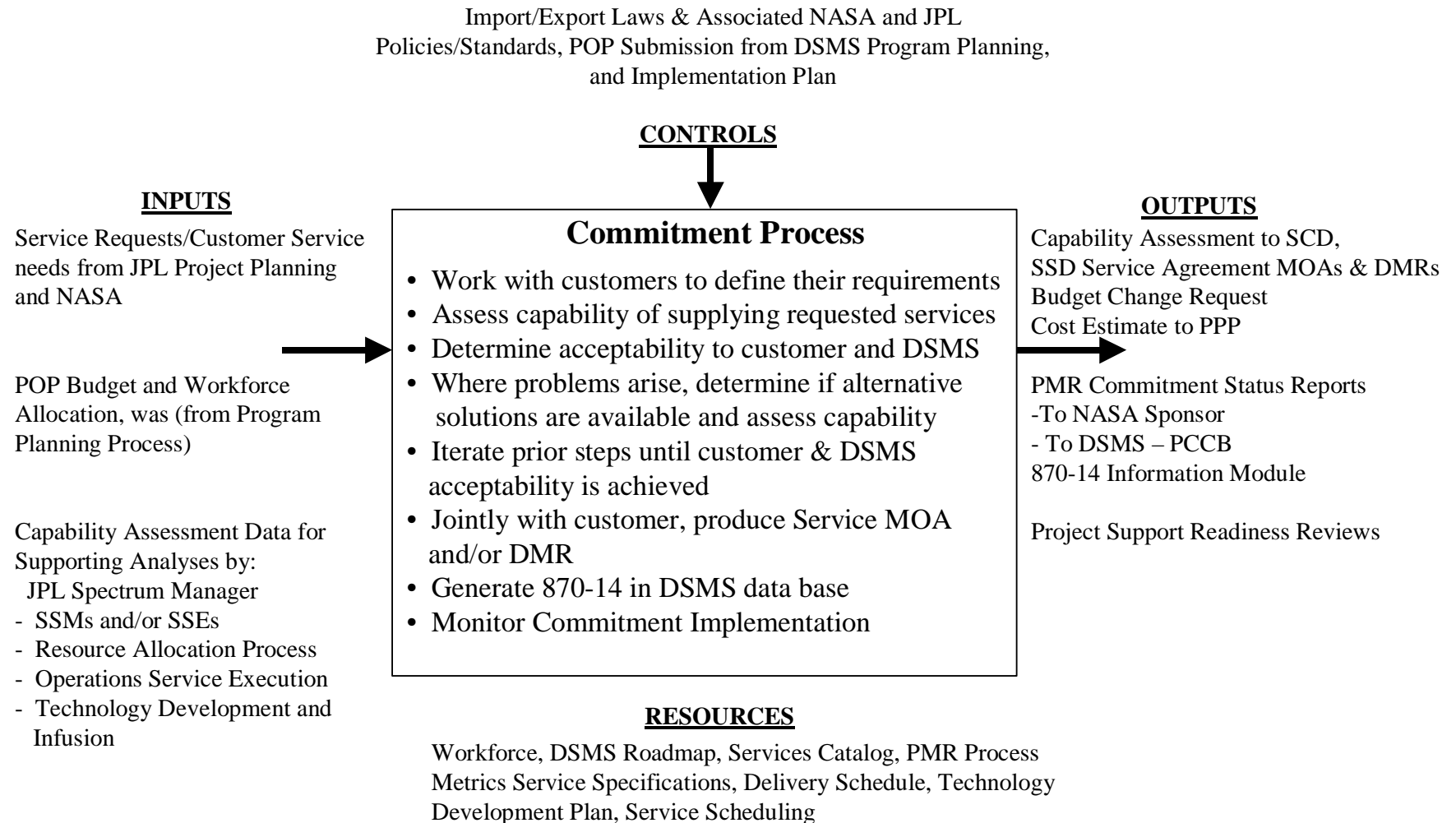


Figure 11-1: Inputs, Controls, Outputs, and Resources for the Service Commitment Process.





## 12 APPENDIX G: SERVICE CAPABILITIES DEVELOPMENT PROCESS

---

Figure 12-1 is an overview of the data flow of the service capabilities development process (SVC). Figure 12-2 is an SVC process timeline for a simple case, and Figure 12-3 is an SVC process timeline when service execution is also involved.



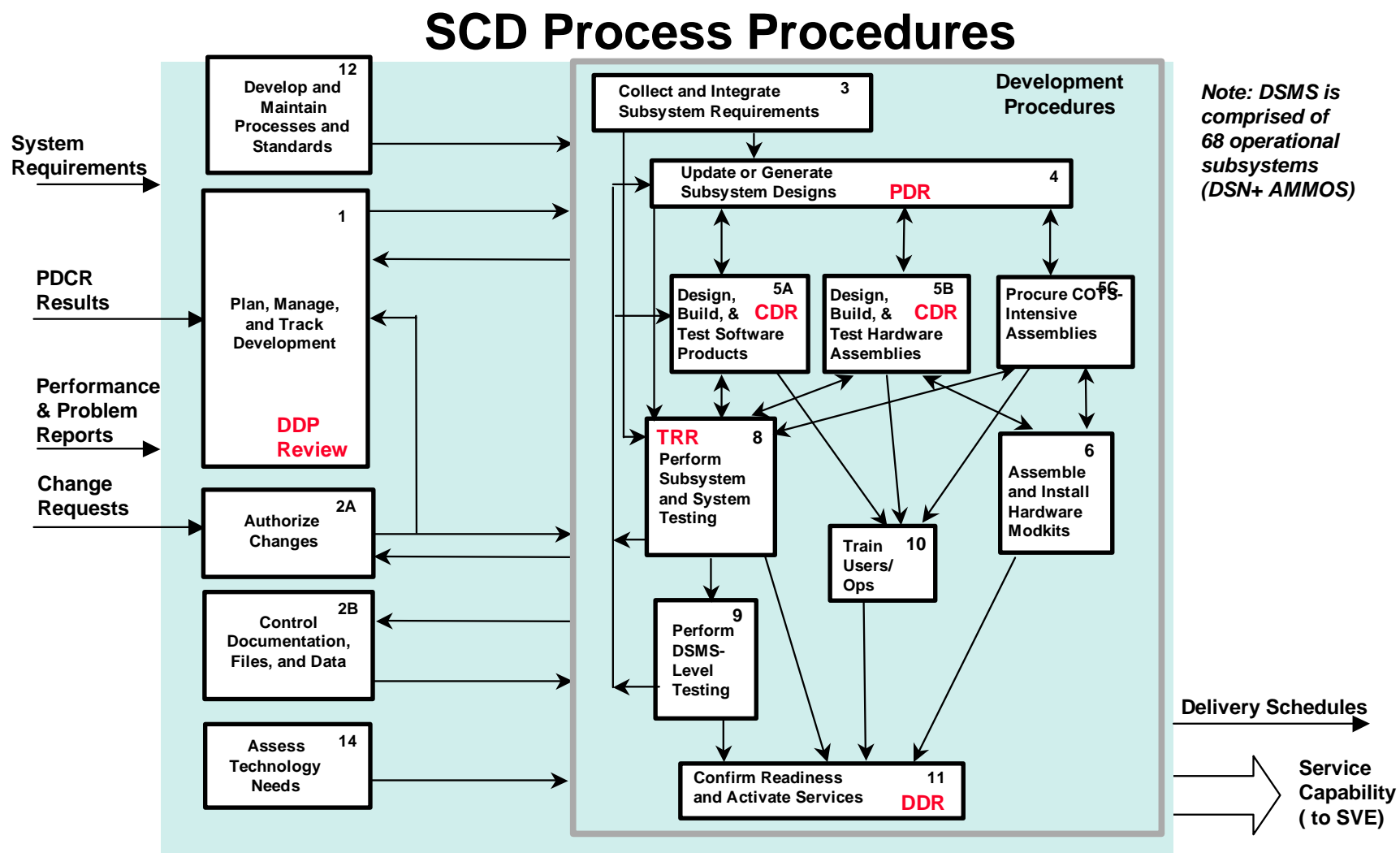


Figure 12-1: Overview of the Procedures for the SCD Process

## SCD Process Timeline (simple case)

(no antenna/facility downtime, minimal on-site AT)

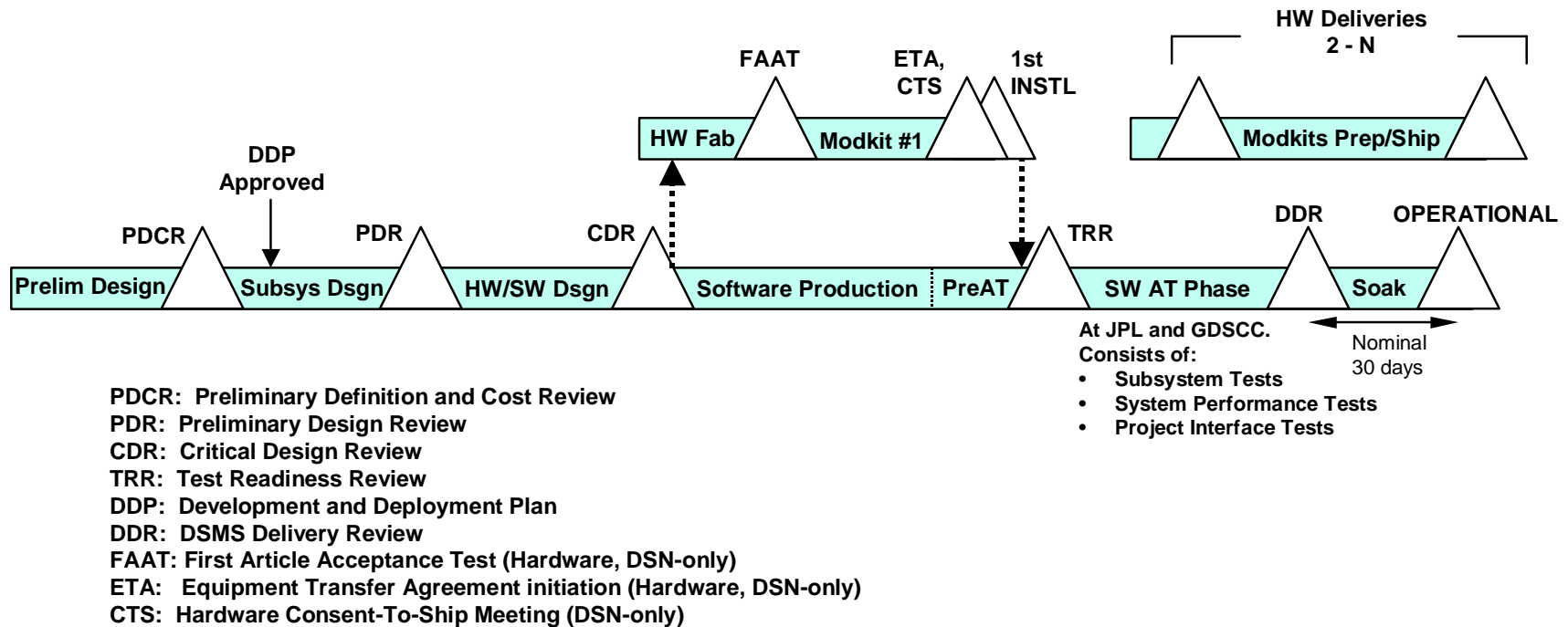
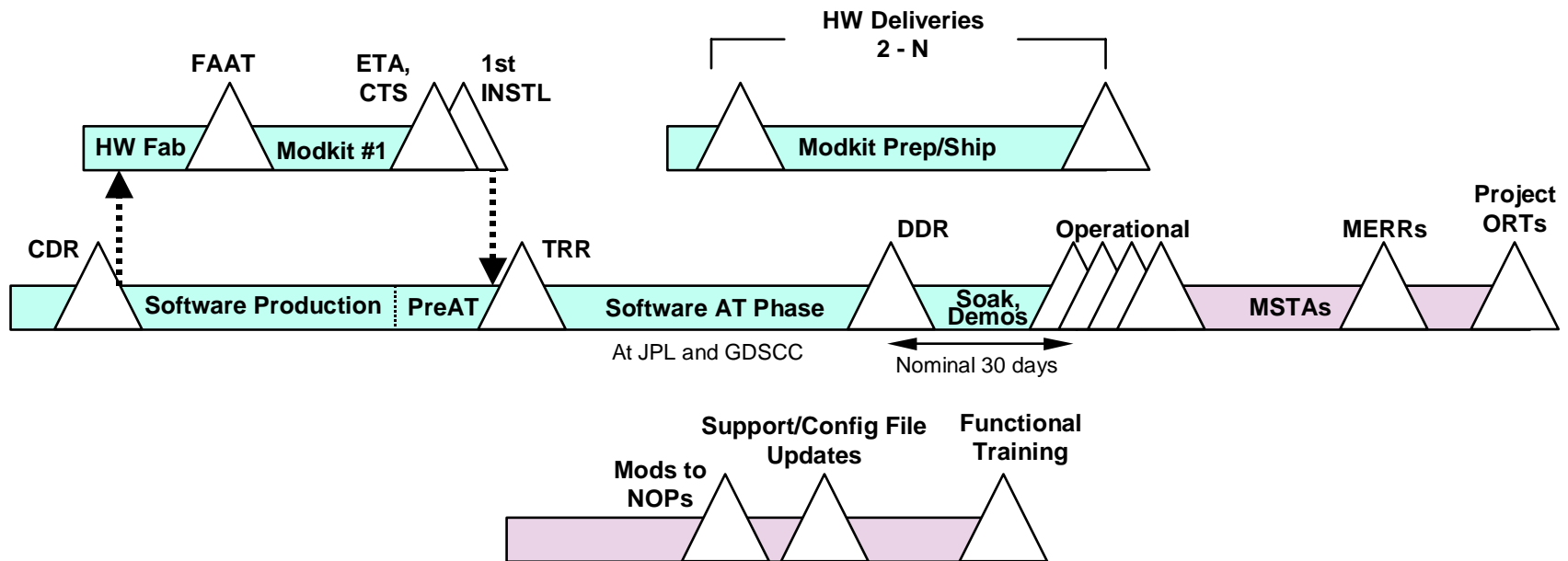


Figure 12-2: SCD Process Timeline for a Simple Case

# Process Timeline with SVE additions



**MSTA:** Mission Services Training Activity  
**NOP:** Network Operations Plan

Figure 12-3: SCD Process Timeline with SVE additions



## 13 APPENDIX H: SERVICE EXECUTION PROCESS

---

Figure 13-1 illustrates the Service Execution Process (SVE). Figure 13-2 shows the inputs, controls, outputs, and resources for this process.





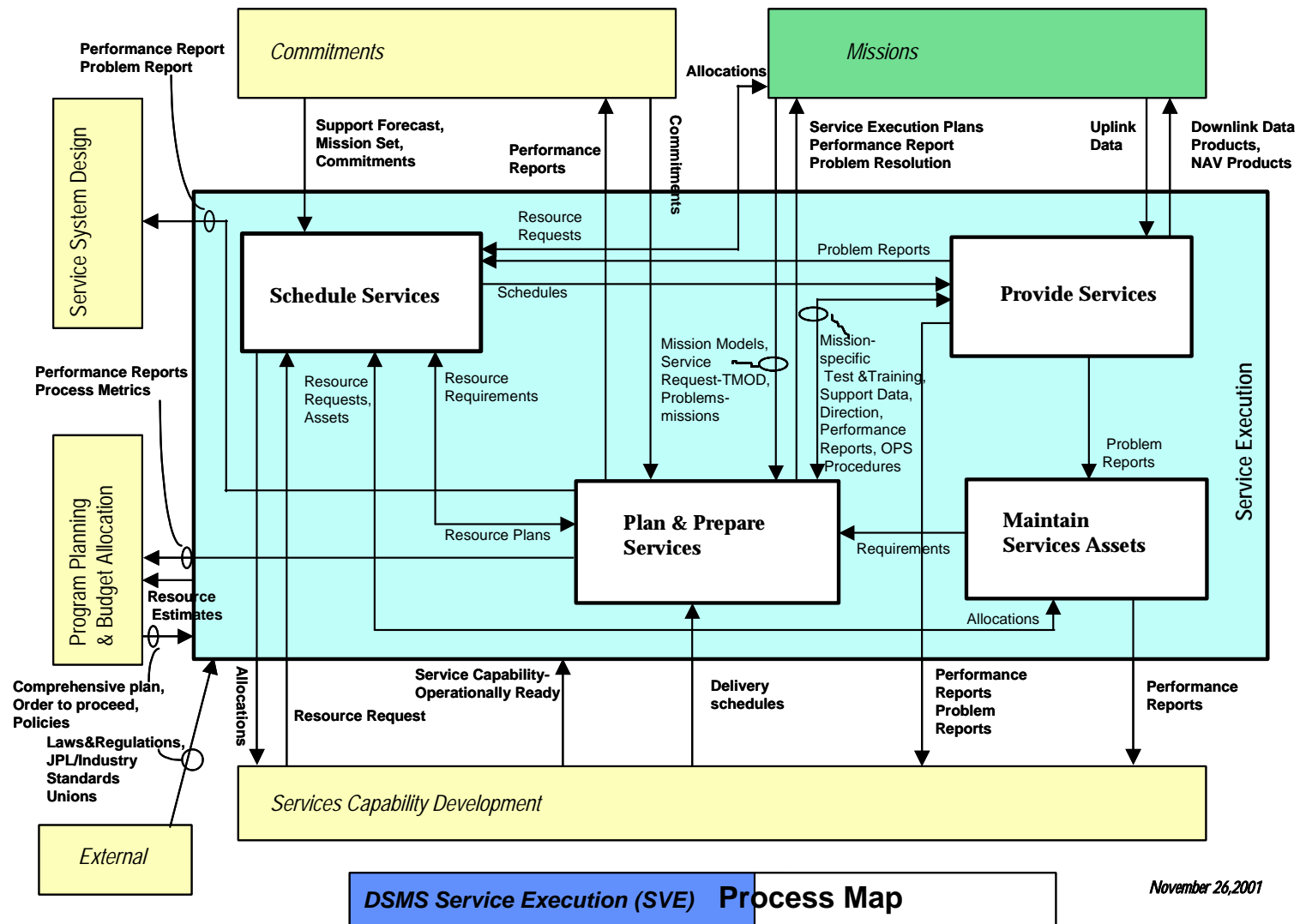


Figure 13-1: Service Execution Process

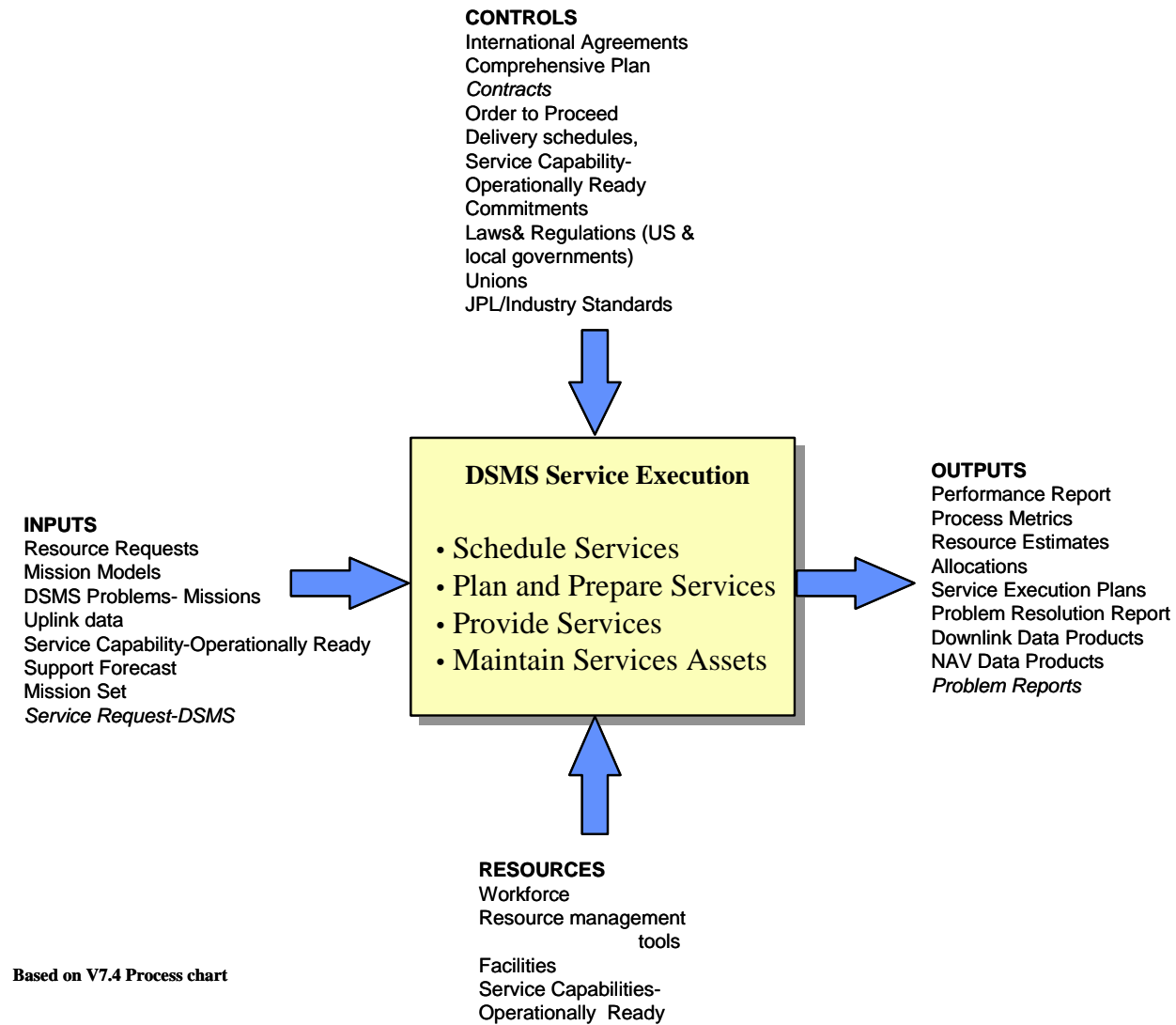


Figure 13-2: SVE Process Inputs, Controls, Outputs, and Resources

## 14 APPENDIX I: PRODUCT ENGINEERING ASSIGNMENTS

---

Following is a table of product engineering assignments.



Contractor Product Engineering Responsibility Assignments

			SSE/CDE Responsibility	Sustaining
Number	Abbr	Title	CTR	CTR
101.4	ASP	70-m Antenna Support Equipment		
101.401	AAC	Antenna Air Conditioning		
101.402	APL	Antenna Power Distribution and Lighting		
101.403	AFP	Antenna Fire Protection		
101.404	GRN	Antenna Grounding		
101.405	AMS	Antenna Maintenance Support Equipment		
102.4	ASP	26m Antenna Support Equipment		
101.401	AAC	Antenna Air Conditioning		
102.402		Power Distribution and Lighting (26-m)		
103.4		11m Antenna Support Equipment		
103.401	AAC	Antenna Air Conditioning Group (11-m)		
103.402	AFP	Antenna Fire Protection/Monitoring		
104.4	ASP	34-m HSB Antenna Support Equipment		
104.401	AAC	Antenna Air Conditioning (34-m HSB)		
104.402	APL	Antenna Power Distribution and Lighting		
104.403	AFP	Antenna Fire Protection		
104.404	GRN	Antenna Grounding		
105.4	ASP	34-m HEF Antenna Support Equipment		
105.401	AAC	Antenna Air Conditioning (34-m HEF)		
105.402	APL	Antenna Power Distribution and Lighting		
105.403	AFP	Antenna Fire Protection		
105.404	GRN	Antenna Grounding		
106.4	ASP	34-m BWG Antenna Support Equipment		
106.401	AAC	Antenna Air Conditioning		
106.402	APL	Antenna Power Distribution and Lighting		
106.403	AFP	Antenna Fire Protection		
106.404	GRN	Antenna Grounding		
111.2		Antenna Calibration Group		
111.201	APCAL	Antenna Pointing Calibration Assembly		
111.202	APCAL	APCAL Boresighting Software		
111.203	APCAL	APCAL Data Analysis Software		
205.2		System Performance Test		
205.202	SPT	SPT Executive Program		
205.203		DSCC Command System Performance Test		
205.204		DSCC Tracking System Performance		
205.206	SPT2	System Performance Test (Type II)		
205.207	SPT2	System Performance Test (Type II) Software		
209	DTK	DSCC Tracking Subsystem		
209.1		Control		
209.202	MTA	Metric and Tracking Assembly		
209.203	MTA	Metric and Tracking Assembly Software		
209.204		Control		

# Contractor Product Engineering Responsibility Assignments

			SSE/CDE Responsibility	Sustaining
Number	Abbr	Title	CTR	CTR
209.304	SRI	SRA-to-RER Interface Assembly		
211.203	CMG	Command Modulation Generator		
211.203	CMG	Command Modulation Generator Software		
211.203	CMG	CMG Off-line Diagnostics		
231.1		26-m Receive and Demodulate		
231.101	MFR	Multifunction Receiver		
231.102		S-Band Downconverter		
231.103		Receiver-Exciter Test Equipment Group		
231.105		26-m RER Slave Controller Software		
231.3		26-m Doppler/Range Group		
231.301		Ranging Firmware (26 m)		
303.1	DMP	26-m Station Link Monitor		
303.101	LMP	Link Monitor Processor Assembly (26 m)		
303.102	LMP	Link Monitor Processor Software (26 m)		
303.2		26-m Station Control		
303.201	MCP	Monitor and Control Processor (26 m)		
303.202	MCP	MCP Applications Software (26 m)		
303.204	RUI	MCP Remote User Interface Software (26m)		
304.1		SPP Product Services Group		
304.101	SPPA	Support Products Provider Assembly		
304.102	SPPA	Support Products Provider Assembly		
304.103		Mission Control Table Generator		
304.104	MCTM	Mission Control Table Manager		
304.105	MCTV	Mission Control Table Viewer		
304.106	TCD	Telemetry and Command Desktop Generator		
304.2		SPP User Interface Group		
304.201	NIS26	26-m Network Information Server		
304.202	NIS26	26-m Network Information Server Software		
306.402	MDDS	Monitor Data Dictionary Service		
306.403	UDS	Uniform Display Service		
306.404	CDT	Command Display Terminal		
<b>309</b>	<b>NSS</b>	<b>Network Support Subsystem</b>		
309.1		NSS Processing Environment		
309.101	NSC	NSS Support Computer Assembly		
309.102		NSS Peripheral Switch Assembly		
309.103	RASM	Remote Access Scheduling Mailbox		
309.113		NSS Cables		
309.2		NSS Applications		
309.201	NSC	NOCC Support Controller Software		
309.202	GRAD	Geocentric True of Date RA/DEC Predict		
309.205	RASM	Remote Access Scheduling Mailbox Software		
309.206	NAVIO	NAV I/O Software for NSS		
309.208		NSS Delta-DOR Utility		
309.209	DFPO	Downlink Frequency Predicts Offset Utility		
313.2		Applications		

Contractor Product Engineering Responsibility Assignments

			SSE/CDE Responsibility	Sustaining
Number	Abbr	Title	CTR	CTR
313.201	NIMS	Network Information Management		
313.9		Maintenance Logistics Support Group		
313.901		Processing Equipment		
313.902	MAXIMO	RCM Application Software (MAXIMO)		
314.101	ECM	Engineering Change Management		
314.104	SPMC	Software Production Management and		
314.201	DOSL	DSN on-line Software Library		
314.202	DOSL	DSN on-line Software Library Software		
321.1		Central Transmission Group		
321.101	CTX	Central Transmission Assembly		
321.102	CCS	Central Communications Switching Assembly		
321.103	CDC	Central Digital Communications Assembly		
321.2		Station Transmission Group		
321.202	FOA	Fiber Optic Assembly		
321.203	STX	Station Transmission Assembly		
321.204	SDC	Station Digital Communications Assembly		
321.206	SCS	Station Communications Switching Assembly		
321.213		Station GTX Cables		
321.3		Remote Site Group		
321.301	EXT	External Transmission Assembly		
321.4		NISN-Provided Equipment Group		
321.401	NTX	NASCOM Transmission Assembly		
321.402	BPIPE	Primary DSCC Communications Channel		
321.403	LPIPE	Secondary DSCC Communications Channel		
322.1		Central Voice Group		
322.101	CDS	Central Distribution Assembly		
322.102	CVS	Central Voice Switching Assembly		
322.103	CVT	Central Voice Terminal		
322.2		Station Voice Group		
322.201	SVS2	Station Voice Switch II		
322.202	SVT	Station Voice Terminal		
322.207	SVS2	Station Voice Switch-II Software		
322.3		Remote Site Voice Equipment Group		
322.301	EVA	External Voice Assembly		
322.302	EVT	External Voice Terminal Assembly		
322.303	EVS	External Voice Switch Assembly		
322.304	RVE	Remote Voice Equipment (DTF-21)		
<b>401</b>	<b>FAC</b>	<b>Technical Facilities Subsystem</b>		
401.1		DSCC Infrastructure		
401.101	CVL	Civil/Structural Analysis Group		
401.102	ACG	Air Conditioning Group		
401.103	GRG	Grounding Group		
401.2		Control and Monitor Group		
401.201	TFM	Technical Facilities Monitoring Assembly		
401.3		Site Security		

Contractor Product Engineering Responsibility Assignments

			SSE/CDE Responsibility	Sustaining
Number	Abbr	Title	CTR	CTR
401.301	SPS	Site Protection System		
401.302	FLG	Facilities Lighting Group		
401.303	TVA	TV Assembly		
401.4		Interfacility Cabling Group		
401.401	ACB	Antenna-SPC Cable Backbone		
401.5		Chemical Storage		
401.501	NSA	Nitrogen Supply Assembly		
<b>402</b>	<b>DPS</b>	<b>Power Subsystem</b>		
402.1		Power Subsystem Control		
402.101	PSC	Power Subsystem Controller		
402.102	PSM	Power System Monitor		
402.2	PGG	Power Generation		
402.3	PDG	Power Distribution		
402.4	UPS	Uninterruptible Power Supply		
<b>404</b>	<b>CRC</b>	<b>Control Room Configurations</b>		
404.1		NOCC/GCF-20 Equipment Arrangements		
404.2	GDSCC	DSCC-10		
404.3	CDSCC	DSCC-40		
404.4	MDSCC	DSCC-60		
404.5	DTF-21	Development Test Facility-21		
404.6	CTT-22	Compatibility Test Trailer-22		
404.7	ECC	Emergency Control Center		
404.8	MIL-71	MIL-71		
<b>405</b>	<b>SCD</b>	<b>Facility System Cable Documentation</b>		
406		DSN Standard Hardware		
406.1	STDCAB	Standard DSN Cabinets		
406.2	STDCBL	Standard DSN Cables		



## 15 APPENDIX J: CONTRACTOR STAFF ROLES

Table 15-1 cross-references by WBS element number the Contractor staff roles cited in the task descriptions.

Table 15-1: Staff Roles Referenced by WBS Element Number

WBS no.	Role name	The Contractor staff filling this role shall:
1.1.3 1.1.4 2.1.3	Certified Safety Professional	Maintains all Cal/OSHA-required record keeping and documentation. Ensures issuance and maintains safety oversight of the required qualifications and certifications for all operators of heavy equipment. Maintains Cal/OSHA certifications, requirements, and testing record keeping and documentation for all antenna hoists and cranes, pressure vessels/systems, electrical systems, radio frequency equipment, lasers, and any other equipment per Cal/OSHA requirements.
1.8	Performance Metrics Analyst	Possess knowledge of basic DSN architecture and operations, statistical methods, data collection, manipulation, analysis, and trend identification.
2.1.1	RF Coordination Manager	Have a SECRET clearance and in-depth knowledge of radio frequency theory.
2.1.4	Registered Environmental Assessor	Registered Environmental Assessor in the State of California
2.1.9	Outreach Coordinator	Be experienced in communicating the capabilities of the Deep Space Network in tracking NASA missions. Be knowledgeable about the missions, their destinations, and science goals. Be flexible in the presentation of such information to interact with all grades of students, teachers, and other educators, in addition to the public and members of the scientific and technical community, and be able to convey they information in a manner appropriate to their level of understanding. Represent the GDSCS by giving presentations on NASA's scientific discoveries and technological achievements to local community groups, students, and local leaders, especially, but not restricted to, the Barstow School District and the Barstow City area. Represent Goldstone at any Fort Irwin sponsored events where the outreach program is a significant addition and appropriate; i.e., Safety Days and environmental events. Support local museums, libraries, and similar organizations by providing materials or information to allow them to accurately represent Goldstone and the DSN in their exhibits. Report directly to the JPL Task Manager.
2.3.1	Antenna Maintenance Personnel	Be able to measure the thickness of the thermal coating to determine if it has been applied per the specification. They shall also be able to use the required tools to repair any damaged or thinned areas on the

Table 15-1: Staff Roles Referenced by WBS Element Number

WBS no.	Role name	The Contractor staff filling this role shall:
		<p>structure.</p> <p>Be able to determine the condition of a bolted connection by either testing the bolt torque or the visual appearance of the hardware itself. To conduct such tests, they shall be able to use of hand tools, torque wrenches, and hydraulic torque equipment.</p> <p>Ensure that antenna maintenance personnel, welding on the antenna are certified per DSN-STD-1015. Maintenance personnel shall know the inspection techniques and equipment used for the inspection of structural welds.</p> <p>Ensure that antenna maintenance personnel can read detail drawings to determine whether a structural member has shifted in any direction. They shall also be able to use measurement equipment to determine material thickness.</p> <p>Be able to operate heavy equipment including forklifts and hoists. They shall also be trained in the proper way to rig structural members for hoisting. They shall be qualified in fall protection and the operation of man-lifts.</p> <p>Maintenance personnel shall know how to determine whether concrete is in good condition. To aid in this determination, they shall know how to place and inspect concrete. They shall be able to place grout per design drawings and procedure requirements.</p>
2.6.1	Complex Research and Development Engineer (CRDE).	<p>Be responsible for the DSCC on-site R&amp;D configuration management, coordination, and training.</p> <p>Support administration and coordination of GDSCC R&amp;D activities sponsored by the Technology Office and the DSN Science Office.</p> <p>Provide general advisory support to DSCC operations.</p> <p>Provide direct support for R&amp;D activities, and for special mission support as required.</p> <p>Provide status, control of technical, and logistics resources needed for R&amp;D activities.</p> <p>Provide coordination and maintenance of R&amp;D equipment, maintenance of the R&amp;D interfaces with Operational equipment, calibration required for R&amp;D equipment, and end-to-end data system validation and/or SPT prior to experiments.</p> <p>Manage local documentation of R&amp;D equipment configuration and local procurement of R&amp;D equipment</p>
2.6.1	Complex Research and Development Engineer (CRDE)	<p>Work directly with, and functionally report to, the Interplanetary Networks Direct (IND) R&amp;D Project Element Manager (PEM).</p> <p>Be responsible for DSCC on-site R&amp;D configuration management, coordination, and training in support of advanced development activities.</p> <p>Administer and coordinate support for GDSCC R&amp;D activities sponsored by the Technology Office and the DSN Science Office.</p> <p>Provide general advisory support to DSCC operations on scheduled</p>

Table 15-1: Staff Roles Referenced by WBS Element Number

<b>WBS no.</b>	<b>Role name</b>	<b>The Contractor staff filling this role shall:</b>
		<p>R&amp;D activities.</p> <p>Provide direct support for R&amp;D activities, and for special mission support as required.</p> <p>Provide status and control of technical and logistics resources needed for R&amp;D activities.</p> <p>Coordinate maintenance of R&amp;D equipment, maintenance of the R&amp;D interfaces with Operational equipment, R&amp;D equipment calibration, and end-to-end data system validation and/or SPT prior to experiments.</p> <p>Manage GDSCC documentation of R&amp;D equipment configuration and local procurement of R&amp;D equipment.</p> <p>Ideally, possess an MS degree in Physics, Astronomy, or Electrical Engineering. PhD is preferred.</p>
2.6.2	HPTTF Staff	Training, experience, and certification in microwave transmitters and their related subsystems
2.6.2	HPTTF Staff: Electronics Specialist	<p>Twenty years design and practical experience with high-power transmitters ranging from under 1 kW to over 500 kW continuous wave and from S-band to X-band.</p> <p>Management experience in the operation of a high-power test facility.</p> <p>Relevant bachelor's degree desired. About two years of additional training will be required by JPL.</p>
2.6.2	HPTTF Staff: Mechanical Specialist	<p>Ten years experience as a general machinist with at least five of those years as a computer numerical control (CNC) machinist/programmer.</p> <p>Certification for operating Fadal-type CNC.</p> <p>Ability to design with mechanical design and CAD packages such as Solid Works, Pro E, Autocad, and Virtual Gibbs.</p> <p>State-certified welding certificate (general steel—architectural).</p>
2.7.4	Packaging Specialist	Be certified, as required, especially for the handling and packaging of hazardous materials and be thoroughly trained in proper techniques, processes and procedures.
4.1.2.1	Structural Engineer	<p>Ensure conformance with the rules and regulations of the national standards for structural assemblies, materials, and welding codes.</p> <p>Be responsible for evaluating the condition of the structural assemblies on the antenna and for developing all rework/repair operations for its components.</p> <p>Monitor maintenance activities and the installation of all additions to the structural assembly.</p> <p>Review the analysis data and design drawings developed by the design-engineering group, for any proposed modifications to the structural assembly.</p> <p>Develop the lift plans for the removal or installation of new members.</p> <p>Provide general DSN Engineering support as described in Section 4.1, as appropriate</p>
4.1.2.2	Mechanical Engineer	Conform to the rules and regulations of the national standards for mechanical assemblies and their design.

Table 15-1: Staff Roles Referenced by WBS Element Number

WBS no.	Role name	The Contractor staff filling this role shall:
		<p>Be responsible for evaluating the condition of the mechanical assemblies on the antenna including the alignments of the gear reducers, condition of the hydraulic and electric drives, condition of all rotating assemblies, and the operational status of the hydrostatic bearing assembly.</p> <p>Develop all installation, rework, and alignment procedures for the maintenance activities on all mechanical assemblies.</p> <p>Review the analysis data and design drawings developed by the design-Engineering group for any proposed modifications to the mechanical assembly.</p> <p>Monitor the condition of the hardware by analyzing the predictive and preventive maintenance reports generated by the maintenance personnel at the stations.</p> <p>Be responsible for keeping track of the availability of replacement hardware.</p> <p>Provide general DSN Engineering support as described in Section 4.1, as appropriate</p>
4.1.2.3	Cassegrain Assembly Engineer	<p>Conform to the rules and regulations of the national standards for mechanical assemblies and their design, materials, and coatings.</p> <p>Develop new procedures used for maintenance activities for the handling and alignments of the reflective structure, subreflector assembly, and mirrors.</p> <p>Analyze antenna performance reports and determines the condition of the cassegrain assembly.</p> <p>Review the analysis data and design drawings developed by the design-Engineering group for any proposed modifications to the cassegrain assembly.</p> <p>Monitor the condition of the hardware by analyzing the predictive and preventive maintenance reports generated by the maintenance personnel at the stations.</p> <p>Provide general DSN Engineering support as described in Section 4.1, as appropriate</p>

Table 15-1: Staff Roles Referenced by WBS Element Number

<b>WBS no.</b>	<b>Role name</b>	<b>The Contractor staff filling this role shall:</b>
4.1.2.4	Special Tooling & Instrumentation Engineer	<p>Design any mechanical equipment needed for the repair, replacement, and alignment of antenna hardware.</p> <p>Monitor the condition of the hydrostatic bearing instrumentation (HBI).</p> <p>Develop any instrumentation that could be used for maintenance activities, and monitoring of antenna components.</p> <p>Review all maintenance records, predictive/preventative reports, and inspection reports submitted by the stations and compile a monthly report on the findings listing any concerns. This report shall be delivered to the Program Office.</p> <p>Review the monthly report on the shimming activities on the 70-meter antenna hydrostatic bearing and generate a report on the condition of the runner. This report shall be delivered to the Program Office.</p> <p>Monitor the status of spares at each station and their availability and generate a quarterly. This report shall be delivered to the Program Office.</p> <p>Provide general DSN Engineering support as described in Section 4.1, as appropriate.</p>
4.1.6	Hardware & Software Test Engineers	<p>Be familiar with industry-standard or IEEE hardware and/or software development and test processes</p> <p>Be versed in test methodologies and theory, and in the fundamentals of design and operations for hardware and/or software (as appropriate to the task).</p>
4.2	Facilities Design Engineer	<p>Possess Architect, Engineer, or equivalent technical education and experience.</p> <p>Function as the Design Engineer for DSCC Facilities.</p> <p>Provide support in the design and construction of facilities systems, and master planning of the DSCC facilities.</p> <p>Support the DSN CoF Program Office.</p>
4.2	Electrical Engineer(s)	<p>Provide support in the design, fabrication, assembly, test and implementation of power distribution, lighting, and grounding systems.</p> <p>At least one Electrical Engineer shall hold current registration as a California registered professional Engineer.</p>
4.2	Mechanical Engineer(s)	<p>Provide support in the design, fabrication, assembly, test, and implementation of HVAC systems and their associated controls, fire suppression and detection systems, and gaseous nitrogen systems.</p>
4.2	Civil Engineer(s)	<p>Provide support in analysis, design, fabrication, assembly, test, and implementation of civil works and structures.</p> <p>At least one Civil Engineer shall hold current registration as a California registered Professional Engineer.</p>
4.2	Designer(s)	<p>Be skilled in the use of AutoCAD design software of release 14 or newer.</p> <p>Possess a minimum of ten (10) years of experience in the design of facilities projects.</p>

Table 15-1: Staff Roles Referenced by WBS Element Number

WBS no.	Role name	The Contractor staff filling this role shall:
4.2	GIS Specialist(s)	Be knowledgeable about the application of the Geographical Information System (GIS), about NASA's use of this tool as related to facilities Engineering, and about NASA's SPECSINTACT System.
4.2.1.2	Cognizant Design Engineer	<p>Perform design of all facilities and antenna support equipment for maintainability and sustainability.</p> <p>Develop requirements and support associated facilities and antenna support equipment functional requirements documents, reviews and construction pre-advertisement reviews as required.</p> <p>Provide input for new facility site locating.</p> <p>Utilize NASA best practices such as Pre-Project Planning and risk management.</p> <p>Support development of facility concept studies as required.</p> <p>Develop requirements selection of A&amp;E services and for input to JPL A&amp;E Selection Board.</p> <p>Provide oversight of facility construction activities and construction contracting. Perform construction project management, develop and execute Facility Activation Plans for all new construction and facility modifications.</p> <p>Perform Project Definition Rating Index (PDRI) assessment and generate PDRI scores for CoF related facility and antenna support equipment projects.</p> <p>Request Authority to Advertise from DSN CoF Program Office for CoF related projects.</p> <p>Prepare and submit Flash Bid Reports as required.</p> <p>Utilize Specifications-Kept-Intact (SPECSINTACT) System for generation of statements of work for CoF projects.</p> <p>Interface with Operations and Maintenance personnel, users, other subsystems to ensure coordination with other DSN subsystems and assemblies.</p> <p>Provide for final acceptance and activation of installed systems.</p> <p>Support Facilities SSE in all aspects of Facilities and Antenna Support Equipment Systems as necessary to ensure DSCC mission readiness.</p> <p>Generate new and update antenna support equipment and facilities related documents, interface agreements, drawings, specifications, functional requirements documents, schedules, and plans as needed.</p> <p>Hold current registration as a California registered professional Engineer.</p>
4.2.1.2	Subsystem Engineer	Supply an Architect, Engineer or equivalent with technical education and experience to function as the Subsystem Engineer for DSCC Facilities and to provide support in the design and construction of facilities systems, master planning of the DSCC facilities and to support the DSN CoF Program Office.

Table 15-1: Staff Roles Referenced by WBS Element Number

<b>WBS no.</b>	<b>Role name</b>	<b>The Contractor staff filling this role shall:</b>
4.2.1.2	Electrical Engineer	Supply an Electrical Engineer(s) to provide support in the design, fabrication, assembly, test and implementation of power distribution, lighting, and grounding systems. At least one Electrical Engineer shall hold current registration as a California registered professional Engineer.
4.2.1.2	Mechanical Engineer	Supply a Mechanical Engineer(s) to provide support in the design, fabrication, assembly, test and implementation of HVAC systems and their associated controls; fire suppression and detection systems and gaseous nitrogen systems.
4.2.1.2	Civil Engineer	Supply a Civil Engineer(s) to provide support in analysis, design, fabrication, assembly, test and implementation of civil works and structures. At least one Civil Engineer shall hold current registration as a California registered professional Engineer.
4.2.1.2	Designer	Supply a Designer(s) and drafter(s) skilled in the use of AutoCAD design software of release 14 or newer. The designers shall have a minimum of ten (10) years experience in the design of facilities projects.
4.2.1.2	GIS Expert	Provide at least one person knowledgeable in the application of the Geographical Information System (GIS) and NASA's use of this tool as related to facilities Engineering and NASA's SPECSINTACT System.